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SOME OBSERVATIONS ON THE CONDITION SOMETIMES CALLED LEATHER-BOTTLE STOMACH

BY STANLEY WYARD, M.D., M.R.C.P., LONDON, ENGLAND

Assistant Physician to the Cancer Hospital

ALTHOUGH extreme and obvious alterations in structure are encountered, there is no other region of gastric pathology in which such confusion reigns as to the exact nature of the change. It is certain that in this name of leather-bottle stomach more than one morbid process is included and, in order to get a clear idea of all of them, it is necessary to examine a number of allied conditions some of which, at first sight, present no similarity whatever. These conditions comprise those that have been at different times and by different writers, called (1) leather-bottle stomach, (2) fibromatosis of the stomach, (3) scirrhus carcinoma of the stomach, (4) linitis plastica, (5) cirrhosis of the stomach, and (6) fibroid induration of the stomach.

An attempt to bring some order into the existing chaos was made in 1913 by Alexis Thomson and J. M. Graham.[1] As regards local fibromatosis their account leaves little or nothing to be added, but in respect to the leather-bottle stomach they "do not think the observations recorded up to the present are sufficient to decide" its pathological nature. I hope in the following observations to do so.

The term leather-bottle stomach is one very commonly employed and familiar to every medical practitioner, but what precisely does it mean? I do not refer now to the pathological characters but to the gross, naked-eye appearance. To what mental picture does the name give rise? I must confess that to me it is but vague and indistinct—a small organ, the cavity of which is of but a few ounces capacity, with contracted walls which are thick, firm, and rigid. But to some it would appear far more definite and includes some hint of the pathological change; it is in other words a diffuse scirrhous carcinoma of the organ. This latter connotation is, I believe, far too narrow and cannot be strictly maintained as is shown by a case which came under my notice 2 years ago. Laparotomy was performed and the condition diagnosed, after manual and visual examination, as leather-bottle stomach. Postmortem the organ was removed and the diagnosis confirmed by the macroscopic appearance. But microscopically the condition is a diffuse colloid carcinoma not a scirrhus (vide Case 7). Yet another case diagnosed by exactly the same means proved histologically to be simple and not malignant at all (vide Case 4). These instances are sufficient, I think, to show that the name in question cannot be used to connote any particular histological structure and should be employed only to denote a certain macroscopic change in the stomach. It is in this sense that I shall employ it hereafter in discussing the subject.

[1] Edinb. M. J., 1913, p. 7.

From the cases which I am about to describe, it appears that the names enumerated above stand for two separate and distinct pathological entities each of which has two subdivisions. The relation of these groups to each other is readily seen in the following tabular presentation:

Fibromatosis of stomach	Local	Leather bottle stomach
	Diffuse	
Carcinoma of stomach	Diffuse	
	Local	

Two are innocent and two malignant while the leather-bottle stomach may be either, and the existence of these two forms explains the difficulty found in deciding whether the condition is one or the other.

LOCAL GASTRIC FIBROMATOSIS

Of this condition I have discovered two specimens at the Cancer Hospital,[1] one from a patient operated on in the hospital by Mr. Jessett, the other presented by Mr. Swan who kindly allows me to use his notes concerning the case. The two specimens are as nearly as possible identical, and one description will answer for both.

The stomach is greatly dilated and the pyloric portion stands out as a firm, tubular mass sharply limited to the right at the pyloric orifice and gradually disappearing to the left. The mass is hard and uniform in consistency, the peritoneum over it smooth and regular; there are no nodules beneath it. There are no peritoneal adhesions, and the tumor was very freely movable in all directions. The mass is 2½ to 3 inches in length and the external diameter at the pylorus 1½ to 2 inches. It extends a somewhat greater distance along the lesser curvature than along the greater. Since both specimens were obtained by operation and neither patient was examined postmortem, the condition of the whole stomach cannot be shown, but Figure 1 is a photograph of one of the tumors after excision (Case 1, No. 126). When the organ is opened the walls of the pyloric portion are seen to be about an inch in thickness, thickest at the pyloric opening, becoming steadily thinner as the distance from the pylorus increases until they pass insensibly into the thin distended wall of the rest of the viscus. The cavity of the stomach is large but the pyloric canal is occluded and its lumen is merely potential. The mucosal rugæ of the fundus are fewer than normal and to a large extent flattened out. Over the tumor the mucosa is extensively destroyed although there is no obvious ulceration. The internal surface of the mass is nodular and the margin toward the fundus is heaped up and irregular; it is quite sharply defined. Inspection of the specimen shows quite clearly that the irregularity is not due to any change in the thickness of the mucosa but of the underlying submucous tissue. The enormous increase in the tissues lying between the remnants of the mucosa and the muscularis is the outstanding feature of both specimens. It is about half an inch deep at its maximum development and shows as a dead white, granular layer, hard in consistency and firm when cut. Its outer margin is crenated and minute bands of it pass outward breaking up the internal muscular coat into bundles of various sizes. The muscular fibers stand out as semitranslucent layers—a wide internal layer with circular fibers, and a narrow external with longitudinal fibers. The processes from the submucous tissue reach and fuse with the layer of fibrous tissue interposed between the two muscular coats which is considerably increased in thickness, but do not invade the longitudinal muscle although in later stages of the disease even this may be extensively involved. It is obvious, however, that there is no great interfibrillary infiltration of the muscles and they are not destroyed as is the case with malignant disease. Although the lymphatic glands along the lesser curvature are enlarged and hard, suggesting malignant infiltration, this is not confirmed microscopically.

The histological appearances are absolutely characteristic and bear no resemblance to a malignant growth. The mucosa may be fairly well preserved or extensively destroyed and represented by mere remnants of the glands which are widely separated and scattered through the superficial parts of the fibrous mass. They show no evidence of any attempt at proliferation and the fibrous tissue is surrounding them, not they penetrating it.

[1] Case 3 was added after this article was written.

The submucous tissues are enormously increased and form a wide layer, reaching as much as 15 millimeters in thickness, superficial to the muscular coats. It is composed of closely packed fibrous cells forming an interlacing fibrillar meshwork. The cells may be well differentiated and of the adult type or of the immature fibroblast type. The proportion of each varies from case to case. Here and there are areas of leucocytic infiltration. In one of the specimens a marked feature is the number of eosinophile cells present—they stand out prominently in sections as large cells with small, deeply staining nucleus surrounded by a wide zone of granular eosinophile cytoplasm (Fig. 2). In this case, too, fibroblasts predominate and the tissue is highly vascular, the vessels are numerous and large indicating a more active condition than in the other specimen in which the cells are more mature and the vessels few and far between (Fig. 3). In both cases the internal muscular coat is penetrated by bands of fibrous tissue which are continuous with the submucous mass. At the periphery of the mass this segmentation of the muscle is coarse, but toward the center, where the fibrosis reaches its maximum the segmentation is finer and the resulting muscle bundles are smaller and irregular in size and shape. Some of the muscle fibers are destroyed. The fibrous septum between the two muscular coats also is increased in thickness and continuous with the fibrous bands that penetrate the inner coat. The whole process amounts to an extreme and apparently progressive fibrosis commencing at or near the pylorus and spreading throughout the wall of the stomach. It is interesting to note that in these cases, as with carcinoma, the disease is sharply limited by the pylorus and does not invade the duodenum.

Clinically, the condition is indistinguishable from cancer of the pylorus, and following are brief accounts of the 2 cases.

Fig. 1. Local fibromatosis of the stomach.

Case 1. (No. 126.) E. G., age 38 years, female. Immediately after a difficult confinement 8 months ago she commenced to vomit and a tumor was noticed by her doctor in the region of the umbilicus. (No more precise localization is available.) Vomiting has been constant and frequent ever since. The bowels have been constipated for years. Latterly the abdominal tumor has grown rapidly and there has been much pain in the right side and in the back. A stomach tube was passed and a quantity of sour-smelling fluid of the color of tea was drawn off. It was found that the stomach was enormously dilated and low in the belly, the greater curvature descending to the symphysis pubis. There was a marked succussion splash. With the stomach empty a pyloric tumor was clearly made out. It was a large, sausage-shaped mass about 2½ by 1½ inches, fairly movable. After treatment by gastric lavage for some days her general condition improved somewhat and Mr. Jessett operated under ether anæsthesia. The pyloric tumor was exposed and a partial gastrectomy performed. The stomach was completely closed as well as the upper end of the duodenum. A gastroduodenostomy was then effected. The patient made an uninterrupted recovery and was discharged cured.

Case 2. (No. 1012.) M. H., age 67 years, female, has had indigestion for many years but in the last few months her symptoms have altered, the chief one now being a complete distaste for any form of food. She has pain in the epigastric area, often increased by food, relieved by eructation of wind. She also occasionally vomits a small quantity of fluid food—never any large amount. This has occurred almost daily for the last week. She has lost much weight lately. Three weeks ago a tumor was discovered in the abdomen. When first seen by Mr. Swan she was thin but not obviously wasted, the tongue moist and clean. In the abdomen there is a rounded flat tumor about 2½ inches in diameter which can be moved about freely in all directions; consistency firm, outline fairly regular; not painful. When the mass is pushed down as far as possible no glands nor other mass can be felt between the tu-

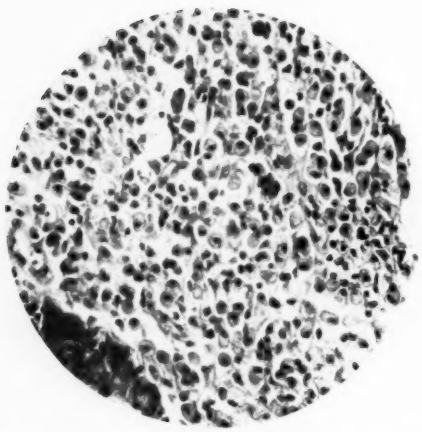

Fig. 2. Section of the tumor from Case 2 (No. 1012). ×200. The eosinophile cells stand out prominently as large cells with small deeply staining nuclei.

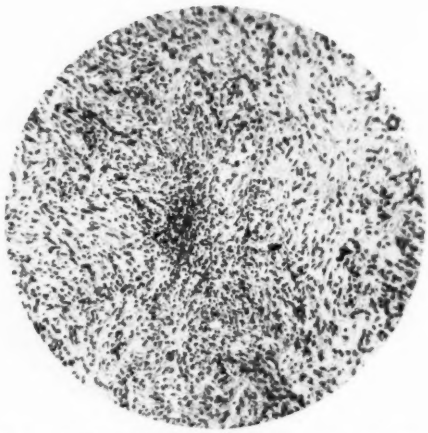

Fig. 3. Section of tumor shown in Figure 1. The fibrosis is far more dense than in Figure 2. There is an area of leucocytic infiltration in the center. ×75.

mor and the epigastric angle. The liver cannot be felt and its area of dulness is normal. Gastric resonance is not increased. The bowels are constipated; the patient has never passed any blood but she has occasionally passed some mucus. There have been no attacks of diarrhœa. A diagnosis of carcinoma of the middle of the stomach was made. Radiography, however, showed a filling defect of the pylorus with some degree of obstruction. As the mass was so freely movable it was decided to operate. Mr. Swan did a partial gastrectomy, completely removing the tumor, and then effected a gastrojejunostomy.

Since this article was written a third case has been admitted to the Cancer Hospital the details of which are as follows:

CASE 3. (No 236/24.) Patient was admitted March 22, 1924, under the care of Mr. C. E. Shattock, whom I thank for permission to use these notes.

A paper-mill hand, aged 37 years, male, complains of "pains in the stomach." On and off for 2 years he has suffered from a burning pain in the abdomen It is situated across the front of the belly at the level of the umbilicus. It does not radiate. Coming on at any time, it has no relation to food and is neither aggravated nor relieved by eating. He vomits frequently, twice daily on an average, generally shortly after a meal. The act is preceded by nausea and it relieves the pain. No hæmatemesis has occurred, nor melæna. There is a constant, nasty taste in the mouth. Bowels are fairly regular. He has wasted considerably. The only previous illnesses are malaria in Salonika in 1917, and an attack of "nephritis" preceding the onset of the present illness. The man is thin and wasted, he looks ill, and the complexion is sallow. The jaws are edentulous; the tongue fairly clean. The abdominal wall is lax but distended, especially below the umbilicus. Intestinal peristalsis is visible and much gurgling is heard within the abdomen. The stomach is distended and a succussion splash can be elicited. There is epigastric tenderness and marked tenderness also in the hypogastrium. No tumor can be detected. The liver and spleen are not palpable. There is some ascites. Examination of the rest of the body reveals no abnormality. There is no enlargement of the retroclavicular glands. The X-rays show the stomach high in position and fixed. There is delay in emptying and definite and persistent pyloric obstruction. A pre-operative diagnosis of malignant disease of the pylorus is suggested. The Wassermann reaction is negative.

Nine days later laparotomy was performed and a large growth discovered at the pylorus. There was some ascites. The patient's condition was such that it was not possible to do anything further and the abdomen was closed. After the operation he went steadily downhill and died on the ninth day.

The postmortem examination revealed general peritonitis due to perforation of Meckel's diverticulum. All the bowel was distended and about the stomach were numerous adhesions. The stomach showed a large mass at the pylorus, the fundus was free and dilated. On opening the organ the pyloric mass was seen almost completely to occlude the canal. It presented an appearance exactly similar to that of Case 1 (No. 126, Fig. 1). On the greater curvature the growth was well defined and did not spread more than some 2 inches, but the whole of the lesser curvature was involved as far as the cardia.

Microscopically the growth consists entirely of fibrous tissue. For the most part the fibers are well formed but fibroblasts are fairly numerous. The fibrosis is most marked and reaches its maximum thickness in the submucous layer. From the sub-

Fig. 4. Case 4. (No. 993.) Diffuse fibromatosis of the stomach. The pylorus is to the left of the picture, the cardia to the right.

Fig. 5. Section of the stomach shown in Figure 4. ×100. The extreme and dense fibrosis is well shown.

mucous layer the fibrosis extends outward breaking up the muscular coats into bundles of varying sizes and increases the width of the subserous tissue. It is fairly, but not extremely, vascular and in many places patches of small round cell (leucocytic) infiltration are seen surrounding the vessels, but there is no generalized infiltration. The mucosa is much altered but not destroyed, the gastric glands are widely separated and represented by a few deformed tubules.

That inflammation certainly plays a considerable part in the course of this disease is further confirmed by the perigastric adhesions. At some time in the course of the illness inflammation had spread from the submucosa outward to the serous coat itself.

ETIOLOGY

It is impossible from a study of but 3 cases to come to any conclusion as to the cause of the condition but four factors deserve attention and may be briefly considered.

1. Syphilis. Nothing in the history of the 2 cases here described, nor in any other recorded case, raises a suspicion that this infection existed. Not in any case, so far as I know, was the Wassermann reaction carried out but there is no certainty that we should be any the wiser were the contrary true. If this condition be syphilitic it is certainly tertiary and no small proportion of tertiary manifestations are accompanied by a negative Wassermann reaction. Although clinical evidence thus fails to enlighten us the histological is, I think, conclusive. There is absolutely nothing in the microscopic characters of the mass to lend support to such an assumption. The newly formed tissue is entirely fibrous without any proliferation of endothelioid elements, giant cells are absent, there is no necrosis and, most important of all, there is no proliferative endarteritis. Finally the cases of syphilitic gastritis which have been described bear no resemblance to this.

2. Tuberculosis. Here again there is no evidence to favor such a supposition. Tuberculosis of the stomach does occur but when the infection has been proved the changes have been quite different from these. No tubercle bacilli can be demonstrated in sections while the absence of endarteritis, epithelioid proliferation and giant cell systems settles the question and leaves no room for doubt. The condition is not an infective granuloma.

3. Neoplasm. Case 1 (No. 126) was originally diagnosed as malignant and was described[1] and shown to several learned societies as a peculiar case of malignant disease of the stomach. Careful examination of the sections, however, fails utterly to support such an interpretation. There is no excess of epithelial elements, the mass consists prac-

[1] Lancet, 1891, ii, p. 921.

tically entirely of mesoblastic tissue. The individual cells, too, are highly differentiated and not in any way atypical. The blood capillaries are well formed and their endothelial lining evident. Nor is the arrangement of the cells atypical. These facts are equally against a diagnosis of sarcoma and confirmation of this is supplied by the absence of blood-spaces without endothelial lining. If anything can be said with certainty concerning these 2 cases it is that they are not malignant.

But the possibility of a non-malignant tumor must also be considered, e.g. a fibroma. Growing from the soft submucosa one would expect a soft fibroma, but these masses are hard and dense. Moreover fibromata are, as a rule, circumscribed and easily shelled out contrary to what is found here. The characters of these tumors, however, very closely resemble those of the fibromatoid tumors, or condition of fibromatosis, which have been described elsewhere.[1] Their size, composition of dense fibrous elements, local infiltration so that no definition of the mass can be made, progressive growth, etc. are all in conformity.

4. Lastly the condition may be inflammatory. Fibrosis is the typical end of chronic, non-suppurative inflammation. There can be no doubt that chronic peptic ulcer may give rise to an extreme degree of surrounding fibrosis so that a palpable tumor may result, but there is reason to believe the present condition distinct from that. Following chronic ulcer the fibrosis does not present the same localized intensity, there is not the same extreme submucous fibrosis, but it extends more widely, involves the whole thickness of the stomach wall so that the peritoneal surface shows evidence of it, and the structures round about are also implicated by the formation of adhesions. As has been seen nothing of this occurred in either of the 2 cases under consideration. There is, moreover, nothing in the history of either to suggest the existence of a gastric ulcer while the mucosal lesion is not sharply circumscribed, not a punched-out loss of substance as is seen with peptic ulcer but is more diffuse and ill-defined both in area and depth. I believe, therefore, that the ulceration of the mucosa is not primary but secondary to the submucous fibrosis and brought about by the interference with its blood supply caused by this fibrosis.

But although the condition is not one of inflammation about a peptic ulcer, nevertheless inflammation is certainly a factor, as is shown by the presence of patches of leucocytic infiltration and scattered eosinophile cells throughout the mass. How the virus may reach the deeper part of the gastric wall, there is nothing to indicate—it may be by metastasis from a distant septic focus, by penetration of the healthy mucosa, a mucosa damaged mechanically by intragastric toxins, or by way of a minute lesion or lesions of the mucosa, possibly an acute ulcer. None of these hypotheses is very convincing, however, for in either case one would expect the lesion to resemble more closely that about a chronic ulcer. The most probable solution of the problem appears to be that the condition is primary and neoplastic, a fibromatosis, upon which is subsequently engrafted an inflammatory element.

SYMPTOMS

So far as the data go it may be said that the symptoms show considerable resemblance to those of carcinoma. There may or may not be a history of antecedent indigestion and if there is, a recent exacerbation of the symptoms is noted. Abdominal pain and vomiting are present, the latter of the obstructive type. The bowels are constipated. There may be flatulence. Appetite is lost and there may be distaste for food. Loss of weight is marked.

On examination an epigastric tumor is felt; hard, not tender, and freely movable. The stomach is dilated, it may be distended with gas; there is a succussion splash and it is low in position—in fact there is pyloric obstruction. No retroclavicular gland will, of course, be felt.

Radiography will confirm the pyloric stenosis and gastric dilatation. It may show irregularity about the pylorus suggestive of malignant disease.

DIAGNOSIS

The disease will probably always be diagnosed as carcinoma, and there are no means,

[1] Adami. Principles of Pathology. i., p. 656.

at present, of distinguishing the two conditions apart from laparotomy and microscopic examination. In a few cases a diagnosis may be made of simple ulceration with fibrosis and again no method of distinction is available. In any case the treatment is the same.

PROGNOSIS

Untreated the disease probably inevitably proves fatal. The pyloric stenosis is progressive and ultimately complete so that unless relieved starvation must result.

TREATMENT

Only surgical treatment is of any avail and it should be a complete cure. Pylorectomy with end-to-end anastomosis or a posterior gastrojejunostomy is the ideal operation though it may not, of course, always be possible because of the patient's general condition.

DIFFUSE FIBROMATOSIS

The condition just described, though local, is apparently progressive and it might, therefore, be expected that it occasionally involves a far wider extent of the stomach wall. It may, in fact, involve the whole viscus but whether in such a case it commences locally and spreads, or whether from the beginning it is of wider distribution cannot yet be determined. When the whole organ is invaded a typical leather-bottle stomach results and is illustrated in Figure 4.

CASE 4. (No. 993.) The stomach is contracted and small forming a sausage-shaped mass which is hard and firm but resilient by reason of its cavity. About the pylorus are numerous tough, well-organized adhesions but elsewhere the peritoneal surface is free and smooth. No nodules are visible in or beneath it. The pyloric portion is chiefly involved and the tumor involves the whole of the lesser curvature as far as the cardia, while along the greater curvature it has spread well round to the fundus, only the extreme apex of which has escaped. The cavity of the organ is much diminished and the pylorus completely occluded. The mucosa is extensively destroyed and but little of it remains, the stomach being lined by the hypertrophied submucosa which forms large, coarse nodules, entirely different from the normal rugæ of the mucous membrane, over the whole internal surface. The walls are thick; in the pyloric end enormously so, as much as 5 to 7 millimeters. The mucosa is not apparently thickened but beneath it is a very wide layer of submucous tissue which in the pyloric antrum invades and extensively destroys the muscular constituents of the wall. Elsewhere the internal, circular, muscular coat is very markedly hypertrophied and stands out clearly as a wide, brown, obviously muscular layer. The process does not penetrate the peritoneum and the gastric omenta are not infiltrated, but along the lesser curvature the lymphatic glands are distinctly enlarged and hard.

The microscopical examination shows (Fig. 5) that the wall is thicker than normal and there is obvious excess of fibrous tissue in it. The mucosa is extensively destroyed and what remains is swollen and œdematous, the glands being widely separated by the great increase in the subepithelial tissues. Here fibrosis is not in evidence. There is some increase in the fibrous elements but it is not extreme. There is considerable, but not dense, leucocytic infiltration, the cells being scattered and separated by the œdematous stroma. The glands as well as being separated, have been largely destroyed by pressure, the epithelium has for the most part been completely destroyed and has disappeared but numbers of desquamated epithelial cells are seen lying among the leucocytes and in some places alveoli still persist in some of which the epithelium is evidently degenerate and dying while in others it presents practically normal characters. There is no evidence whatever of any proliferation of the glandular cells. The muscularis mucosæ is apparently completely destroyed and in those parts of which sections have been prepared no vestige of it remains. Beneath the swollen and degenerate mucosa lies a wide layer of fibrous tissue which attains a depth of up to 15 millimeters or thereabout. It is composed of a close meshwork of recently formed fibrous cells among which are numerous fibroblasts. The arrangement of the fibers presents no attempt at regularity but they pass in all directions indiscriminately. The layer is highly vascular and contains many large vessels with numerous capillaries. Here and there are seen small collections of leucocytes but they are rare. Beneath the peritoneal investment of the organ is another layer of fibrosis from 1.0 to 1.5 millimeter in thickness. Unlike the submucous tissue this is dense and composed of well formed fibers among which fibroblasts are few in number. Nor is it highly vascular but the vessels are scarce. All layers of the muscular coat are invaded by the fibrosis, the muscles are segmented into numerous bundles consisting of but a few fibers up to considerable collections of them. Many of the muscle fibers are swollen and vacuolated and their nuclei have disappeared, evidence that the muscle is undergoing fairly extensive destruction. Nowhere throughout all the sections is there any change even remotely suggestive of malignant disease.

The clinical notes are very briefly as follows: M. H. female, 53 years of age, was admitted to the Cancer Hospital complaining of "stomach trouble." For the past two years she has noticed that she is

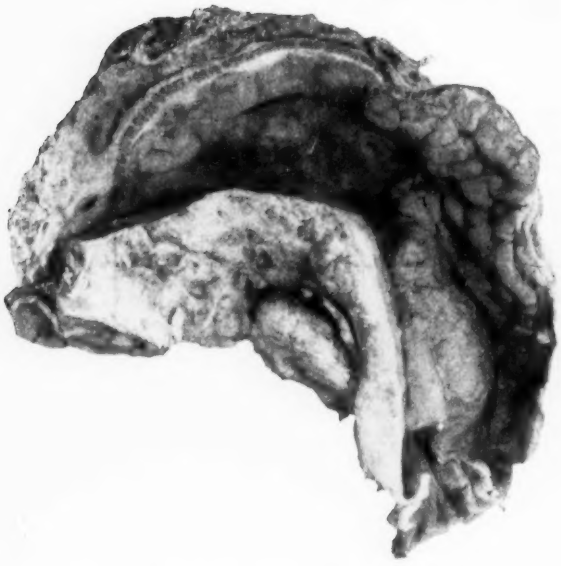

Fig. 6. Diffuse scirrhus carcinoma of the stomach.

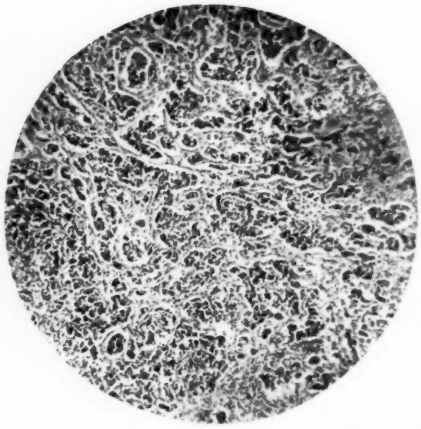

Fig. 7. Section of the stomach illustrated in Figure 6. ×50.

getting thinner and during that time has had much flatulence and nausea. The latter comes on immediately after any food but she rarely vomits. There has never been jaundice. For nearly twelve months she has also suffered from a "drawing" feeling in the abdomen and has been able to feel a lump in the neighborhood of the navel. She is constipated. Her appetite is poor from lack of desire for food, not on account of pain. She has never vomited blood nor passed any *per anum*. For a month or so past she has been very easily fatigued. She has had no previous illness of note.

On examination she looks some 20 years older than her age. The abdomen is distended and there is visible small gut peristalsis. Gurgling is felt along the course of the large bowel. A stony hard, sausage-shaped tumor is palpable lying transversely immediately above the umbilicus. It is about 5 inches long, not tender and very freely movable in all directions. No glands can be felt in abdomen or neck.

Laparotomy was performed and a typical leather-bottle stomach exposed. Excision and gastro-enterostomy were alike impossible so the abdomen was closed. For some months she improved very markedly but later relapsed, the vomiting returned and she suffered much abdominal pain. A second mass was now discovered in the midline above the symphysis pubis and vaginal examination led to the diagnosis of secondary malignant disease in or near the left ovary. Her condition henceforward became steadily worse and although the epigastric mass was somewhat less definite than previously the hypogastric mass was steadily increasing in size, other nodules appeared in the abdomen and ascites developed. Several times abdominal paracentesis was performed but the patient gradually sank and died 10 months after the operation.

Postmortem examination revealed the stomach condition as already described with carcinoma of both ovaries and numerous secondary peritoneal nodules.

Pathology. There is no reason to believe that the pathology of this case differs from that of the 3 cases of local fibromatosis described and the probability is that this is only a further stage of those. Anyhow it absolutely settles the fact that some cases of leather-bottle stomach are due to non-malignant disease.

The symptoms, diagnosis, and prognosis are identical in the two conditions. The treatment, unfortunatly, is not so satisfactory. Gastrectomy is impossible as also is gastro-enterostomy so that surgery utterly fails us as a means of radical cure. A jejunostomy, however, might well be tried and should be of great service.

Apart from operative treatment colloidal selenium was tried and seemed at first to confer very marked benefit. The patient ceased vomiting, the pain practically disappeared, the tumor became less palpable and she put on some weight. The improvement was maintained for a few months but the effect of the ovarian cancer finally dominated the scene and caused death. Records of treatment with

Fig. 8. Diffuse cylinder-cell carcinoma of the stomach.

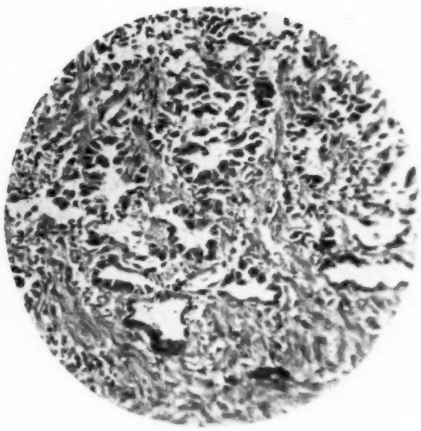

Fig. 9. Section of the organ shown in Figure 8. ×125. Compare with Figure 7 in which the fibrous tissue is more abundant and the malignant cells are more closely packed and relatively less numerous.

colloidal selenium are being collected and, with full details of the method, are being published in another place.

DIFFUSE CARCINOMA OF THE STOMACH

Although it has been definitely shown that leather-bottle stomach may be simple there is no doubt that the majority of cases are malignant. The type of malignant disease is not, however, always the same, nor is it necessarily a scirrhus cancer. I have been able to obtain the specimens and sections from 8 cases, of which 1 was non-malignant, and 7 malignant. As will be seen the growth may be one of 3 kinds: (1) scirrhous carcinoma (2 cases), (2) cylinder cell carcinoma (2 cases), and (3) colloid carcinoma (3 cases).

1. *Scirrhus carcinoma* is illustrated by

CASE 5. (No. 621.) In Figure 6 it is seen that the whole organ is contracted and smaller than normal. The peritoneal surface is free from adhesions but studded, except at the fundus, with numerous nodules, whitish in color and varying in size from a millet seed to a pea (1 to 3 millimeters in diameter). The lumen is much diminished and would not contain half a pint of fluid. The whole of the pyloric portion is invaded by a large tumor which produces a thickening of the walls, and, on the posterior aspect, has extensively destroyed the mucous membrane. The ulcer has a clean nodular base and is, for the most part, quite sharply defined. The new growth is strictly limited to the right by the pylorus, the walls of the pyloric canal being much thickened and the lumen almost completely obliterated. Along the lesser curvature the growth extends as far as the cardia and in the fundus forms a large, pear-shaped mass, about 6 centimeters in length by 2.5 centimeters, which projects into the cavity of the organ and so still further diminishes its capacity. Over this mass the mucosa shows several small areas of superficial ulceration but is for the most part intact. The lower end, or stem, fades steeply into the ulcer on the posterior wall. On the greater curvature the growth extends about half way to the cardia and passes insensibly into the unaltered wall of the fundus. In this unaffected part the mucosa appears more or less normal and presents the usual rugose arrangement. That portion of the wall involved in the growth is increased to as much as 12 millimeters in thickness and there is much destruction of the muscular coats, especially in the lesser curvature. Even when the muscle has escaped destruction strands of growth may be seen penetrating it and forming subperitoneal nodules. In this way the malignant process has spread well beyond the limits of the stomach and the gastrohepatic and gastrocolic omenta are widely infiltrated, forming large masses along both curvatures of the organ. These masses are nodular by reason of the enlarged lymphatic glands incorporated in them, one of which is seen in the lesser curvature measuring 3.3 by 1.6 centimeters.

Histologically the growth is a typical scirrhus (Fig. 7), but instead of forming a mass the growth

Fig. 10. Diffuse colloid carcinoma of the stomach. The pylorus is to the left of the picture, the cardia to the right.

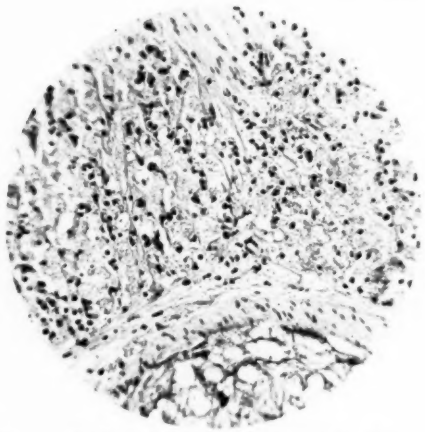

Fig. 11. Section of the stomach shown in Figure 10. ×150. Colloid cancer.

spreads in the submucous planes. Beneath a normal mucosa columns of polygonal cells are seen infiltrating the stomach wall. Individual columns are small and the fibrous stroma round about is well developed so that the growth is not a highly cellular one but hard and fibrotic.

2. *Cylinder cell carcinoma.* Every gradation exists between scirrhus and cylinder-cell carcinoma and to draw any hard and fast line of distinction between them is impossible. In both cases the characters of the parenchymal cells are the same and their arrangement is not essentially different, the distinction lies in the relative amount of parenchyma and stroma. In the scirrhus type the stroma preponderates markedly and in the center of the mass the contraction of the fibrous tissue may so constrict the columns of malignant cells as to cause their death. In the cylinder-cell variety the two tissues are more equally represented. But it seems at best a distinction without a difference and were not both described in current text-books of pathology they would not be separated here.

Case 6. (No. 446, Fig. 8.) The whole stomach is contracted and very small, the cavity will contain not more than 4 to 5 ounces of fluid. The mucosa is everywhere destroyed and nowhere presents the normal velvety appearance. In the fundus there is extensive, irregular, patchy, superficial ulceration but the pyloric end of the organ is partially filled with a warty, irregular growth without real fungation. The walls are much thickened in their entire extent but the thickening is especially marked at the pylorus. Here the submucosa is in places nearly half an inch thick and of a dull white color. The muscular coats are well preserved and stand out well from the growth. The subserous tissue is also thickened and shows as a well marked white band between peritoneum and muscle. Towards the fundus the muscular coats are widely, in places completely, destroyed so that the wall of the organ here consists largely or entirely of malignant growth. Along the subserous planes the growth has spread to the gastrohepatic and the gastrocolic omenta which are infiltrated and contracted. The former contains a large secondary mass of growth lying in the lesser curvature, the latter forms an elongated sausage-shaped mass lying along the greater curvature.

In microscopic section (Fig. 9) this is seen to be a diffuse carcinoma which fairly closely resembles Case 5 (No. 621); but whereas in the latter the fibrosis is more in evidence, here the cellular elements predominate; here there is very great development of fibrous tissue in the submucosa but the growth, which invades almost entirely the mucous layer is highly cellular and the fibrous stroma but little marked; there the increase of fibrous tissue is entirely in the growth, surrounding the columns of malignant cells. In this case the mucosa is generally preserved but much altered and converted into a carcinoma. It infiltrates the underlying tissues but slightly and much of the mucosa presents fibrous hyperplasia free from malignant invasion although here and there the lymphatic channels are seen filled with carcinoma cells spreading down from the surface growth. There is no evidence of the submucous infiltration seen in Case 5 (No. 621).

3. *Colloid cancer* is one of the most rapidly and extensively infiltrating types of the disease and it is common, therefore, when it is situated in the stomach, to find it involve the whole, or almost the whole, of the organ. Thus in Figure 10,

CASE 7 (No. 1016), merely the extreme apex of the fundus escapes. Elsewhere the wall is very greatly thickened by a deep mass of opaque white growth internal to the muscular coats, and a similar but somewhat narrower mass in the submucous plane. The muscular tissues are for the most part preserved but in places the wall is composed entirely of new growth. The mucosa is completely destroyed over the area of the tumor but a small amount remains in the fundus of the organ. The internal surface of the stomach is rough and nodular. Under the peritoneal layer also are numerous nodules and the growth has extended into both mesenteries which are thickened, hard, and contracted. The growth is absolutely limited to the right by the pylorus and does not invade the duodenum. The naked eye appearances are in no wise characteristic and it was not until microscopic sections were examined that the colloid degeneration was discovered. In the 2 other cases, however, their nature was obvious at the first glance.

Microscopically (Fig. 11) the picture is typical; the growth is cut up into lobules by fibrous septa and there is some pericellular fibrosis. The parenchyma cells are for the most part destroyed by colloid degeneration, only in the central parts of the lobules are a few living or moribund cells to be seen. The condition could not be mistaken for anything else.

The etiology, symptomatology, diagnosis, and treatment of these cases do not differ from those of carcinoma ventriculi as a whole and do not call for particular notice here.

LOCAL CARCINOMA OF THE STOMACH

The main characters of this disease are so generally known and the subject is so wide that I do not propose to deal with it here. In any case it is not strictly germane to the subject of this paper and is only mentioned to complete the tabular representation given previously.

SUMMARY

Leather-bottle stomach is thus seen to be neither a clinical nor a pathological entity and is a name that should be abandoned as serving no useful purpose. The controversy as to its nature, whether simple or malignant, is also settled since it may be either the one or the other. Diffuse fibromatosis or diffuse carcinomatosis are suitable names which aptly designate the two conditions included by the original term.

POLYPOSIS OF THE COLON

A Survey of the Subject

By JOHN F. ERDMANN, M.D., F.A.C.S., and JOHN H. MORRIS, M.D., New York
From the Surgical Department, New York Postgraduate Hospital

THE growing frequency and prominence in the literature of articles on the subject of polyposis of the colon is indicative of the increasing interest which a developing knowledge of this condition has stimulated. It has been the privilege of the senior writer to have observed over a period of years a considerable number of these cases, and upon the basis of such observations we would open a discussion of the subject by emphasizing the fact that this disease is essentially one of early adult life with a marked predilection for the male sex.

The occurrence of simple, benign, intralumenary tumors of the gastro-intestinal tract has long been a matter of such common observation that their appearance has ceased to excite more than passing interest. We recognize the frequent association of intestinal polyps with intussusception (Fig. 1), intestinal obstruction, and a variety of vague abdominal symptoms. But until the presence of these intestinal polyps is signalized by some acute abdominal calamity, they are regarded as of little clinical or pathological importance.

Experience and investigation, however, prove that gastro-intestinal polyposis is a condition which merits more than academic interest and that its study, in spite of the obvious difficulties in the way of its efficient treatment, will supply information of practical value to the surgeon as well as to the pathologist.

The term polyp is, unfortunately, too commonly employed in its morphological sense only and implies, in a general manner, any pedunculated or sessile intralumenary tumor varying in size from a pea to a grapefruit. It is, therefore, disconcerting, although not surprising, to find that the pathological conception of the term varies with different clinicians all the way from fibroma through lipoma, myoma, and adenoma.

Because of this confusion and in view of the unusually heavy burden which prognosis and treatment of this condition place upon pathology, a uniform and explicit pathological classification and nomenclature are of primary importance.

In 1906, Dewis, in a review of the literature on the subject of benign tumors of the gastro-intestinal tract, was able to collect a series of 219 cases in which accurate microscopic studies were made. An analysis with classification of these tumors, on a pathological basis, results in the following figures:

Tumor	Total No.	Per cent	Rectum	Per cent
Angioma	3	1.3	2	66
Fibroma	5	2.2	2	40
Myoma	40	18.2	10	25
Lipoma	44	20.	6	14
Adenoma	127	57.9	81	64

The striking preponderance of adenomata among these tumors focuses our attention upon them and a further comparison of their anatomical distribution in relation to all other forms is of significant interest.

Tumor	Small gut Per cent	Large gut Per cent	Rectum Per cent
Adenoma	11	25.2	63.8
All other forms	48	27.1	24.8

The adenomata then increase in frequency in direct proportion as we proceed distally through the gastro-intestinal tract. In the small gut other tumors are four times as common; in the large gut they are present with the same frequency as all other forms combined, while in the rectum they are three times as common as all other forms combined.

Further analysis of this series discloses the fact that while polyps in general present themselves as solitary or as a few scattered tumors, adenomatous polyps occur frequently and usually in a multiple and widely disseminated form. There were but two cases of multiple dissemination recorded in the entire group of non-adenomatous tumors—one among the

lipomata and one among the fibromata. It is also worthy of note that the fibromata, usually regarded clinically as the common type of intestinal polyp, occurred in only 2 per cent of this series.

From the foregoing, we may summarize as follows:

1. Gastro-intestinal polyps may be—histologically, adenomata, fibromata, lipomata, myomata, or angiomata.

2. Adenomatous change, however, is the common histological picture, its preponderance increasing in direct proportion as the distance from the ileocæcal valve increases distally, and it shows a distinct tendency to favor the large gut.

3. Adenomata, unlike other forms, occur but rarely as solitary tumors, frequently as scattered tumors, and are almost unique in assuming a multiple or disseminated character.

Various writers on this subject have attempted further classification within the adenomatous group itself. For instance, Lockhart-Mummery proposes to separate these tumors into four groupings on a basis of associated pathology and apparent etiology, as follows: (1) true multiple adenomata; (2) polyps found in association with hyperplastic tuberculosis; (3) multiple polyps found in association with old strictures of the colon.

4. Polypoid condition resulting from ulcerative colitis.

Woodward proposes still another group under the term "pseudopolyposis of the colon" and characterized by the formation of polyps arising from islands of mucous membrane isolated in the bases of dysenteric ulcers. He distinguishes this condition definitely from that described by Virchow under the term colitis polyposa as a disseminated, multiple tumor formation of idiopathic origin in the colon.

Although the morphological and anatomical characteristics of these various types of adenomata seem to justify the above complex classification, we are impressed by the fact, in a histological study of these groups that they, one and all, represent merely a difference in degree of the same inciting cause. Accordingly, for practical purposes, we assume all adenomatous polyps to be of basically similar

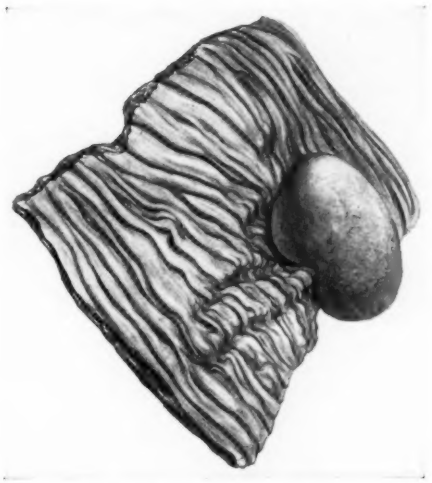

Fig. 1. Dr. Moorehead's case. A solitary fibromyoma of the ileum producing an intussusception of the small gut. For contrast with the adenomatous polyps of the large gut.

nature and therefore refrain from separating them into groups determined by morphology.

As a substitute for the pathological grouping, we believe that, by reason of their clinical features, these cases fall naturally into one of two types and upon this—the clinical basis—we suggest the following simple classification of polyposis of the colon: (1) adult (acquired) type; (2) adolescent (congenital, disseminated) type.

ADULT (ACQUIRED) TYPE

The first form is evidently acquired during adult life and presents itself grossly as a few scattered polypoid tumors closely associated with frank evidences of chronic irritation of mucous membrane such as hæmorrhages, erosions, ulcerations, strictures, etc.

Routine autopsies repeatedly disclose the fact that these tumors are frequently symptomatically silent throughout life; on the other hand these apparently innocent tumors do at times initiate symptoms which threaten the life of the patient unless accurate diagnosis and efficient treatment are obtainable.

The senior writer has recently had under his care a male patient of 50 years of age who for a period of several years complained intermittently of rectal bleeding, vague abdominal and digestive symptoms,

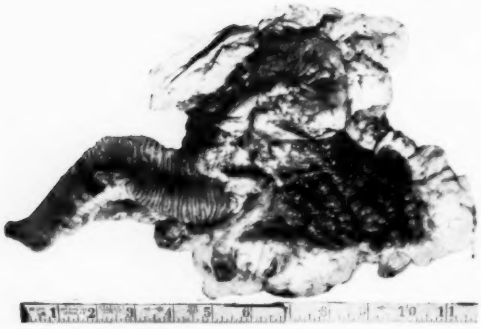

Fig. 2. Senior writer's case showing (a) diffuse mucous membrane hyperplasia of the cæcum manifested as multiple sessile polyps and (b) sharp limitation of the process to the large gut.

and progressive loss of weight. This patient was subjected to endless diagnostic procedures which included gastro-intestinal X-ray and proctoscopy and finally was advised that he had a bleeding duodenal ulcer, disclosed by X-ray, which demanded laparotomy. Sigmoidoscopy revealed a pedunculated, large olive sized tumor about 18 centimeters from the anal sphincter. This tumor, as one might safely predict, was a typical adenomatous polyp and its removal through the sigmoidoscope by means of a snare completely relieved the patient of all his troublesome symptoms.

ADOLESCENT (CONGENITAL, DISSEMINATED) TYPE

The second type, manifesting itself early in youth by intermittent, profuse rectal bleeding and dysentery with consequent secondary anæmia, presents a definite, clean cut, and unmistakable picture which may be supplemented by a history involving other members of the same family. The mucous membrane of the gut, usually colon from ileocæcal valve to anus, is thickly and uniformly studded with multiple adenomatous polyps without apparent concomitant signs of etiology as seen in the first group (Fig. 2).

The contention may still be made that these two types represent merely a difference in degree of the same process, i.e., adenomatous hyperplasia, but the very obvious difference in their clinical pictures justifies the grouping suggested.

Virchow, in 1863, first described the disseminated form under the term of colitis polyposa, but it was not until 1882 that real interest was stimulated by Cripps who was privileged to observe and describe three cases occurring in the same family.

His first patient, a boy of 20 years, had first noted rectal bleeding when he was 10 years of age. During the ensuing 10 years, he was repeatedly operated upon and polyps were removed per rectum with temporary relief only. When seen by Cripps, patient was suffering from a marked secondary anæmia, painful defæcation, bloody mucous discharge and, at times, profuse rectal hæmorrhage. He could, at will, protrude an egg size mass from the rectum and a proctoscopic examination disclosed, as far as eye could reach, the rectal wall thickly studded with vascular, pedunculated tumors varying in size from a pea to a cherry.

While still under observation, this patient suddenly succumbed to an acute intestinal obstruction which, upon autopsy, proved to be due to an adenocarcinomatous stricture of the sigmoid, adjacent to which the bowel was thickly studded with multiple, pedunculated polyps. Subsequently, the same observer saw a brother 17 and a sister 16 of the first patient, both of whom had complained of rectal bleeding and painful defæcation as long as they could remember. Specimens of polyps taken from both of these latter showed the typical adenomatous structure.

Stimulated by the unusual features of these cases, Cripps made a careful study of the specimens together with others which he was able to collect in a search of the London laboratories. In consequence of this study, he described what he believed to be a rare clinical entity, a composite picture of which is somewhat as follows:

The mucous membrane of the bowel, usually from the ileocæcal valve to the rectum, is studded with small tumors varying in size from a pea to a walnut, some pedunculated and some sessile. They are disposed more or less uniformly over the surface of the gut, two to six to the square inch. The individual tumor may have a narrow pedicle and present a clubbed or branching head; or it may appear as a minute glove finger protruding into the lumen of the gut. Some are described as giving the appearance of the mucous membrane having been slashed into ribbons which are left attached at one end. Many unite at their extremities while frequently several seem to arise from a common branching pedicle. In conclusion, he calls attention to the fact that, whereas the single

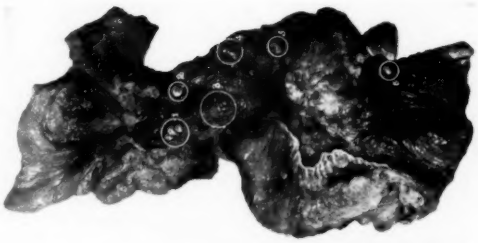

Fig. 3. Demonstrating the non-specificity of adenomatous polyps. A few scattered pedunculated polyps occurring in association with a chronic inflammatory thickening of the cæcum. Nature of process not definitely determined.

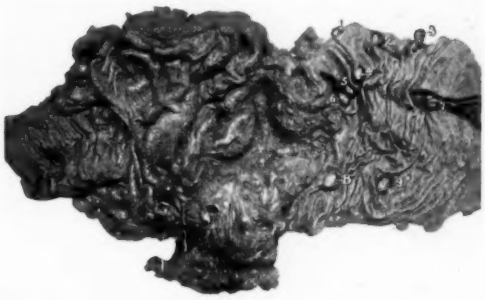

Fig. 4. Dr. Russells' case. Ulcerating adenocarcinoma of cæcum with scattered pedunculated polyps distributed about its margin.

or few scattered variety (our first group) of polyposis is of frequent occurrence, this multiple disseminated variety is extremely rare; that it seemed most common in early youth, had a definite familial tendency and was probably intimately related to intestinal cancer.

Subsequent literature has not been wanting in clinical experiences supporting these early theories. For example, Hanford in 1890 removed from a woman of 34 years a rectal polyp. She died 5 months later as a result of an acute intestinal obstruction. Autopsy revealed a colon studded with adenomatous polyps one of which had infiltrated the submucosa and muscular coats to produce a stricture. Niemack reports the case of a girl of 12 years who for 3 years had presented typical symptoms and in whom a proctoscopy disclosed the usual lower gut picture. This child died while under observation and it was found at autopsy that her colon was beset by multiple adenomatous polyps, one of which had definitely passed over the border line into an early adenomatous stage. Some months later, this girl's father reported complaining of hæmorrhoids and 2 years afterward again appeared with a rectal carcinoma with which were associated a number of polyps. And finally, a nephew of the last patient, 29 years of age, presented himself giving a history of 2 years' intestinal hæmorrhage which, upon rectal examination, was found to arise from a number of scattered polyps.

Upon the service of the senior writer, we have had ample opportunity to study the interesting features of this disease. Illustrative of the adolescent feature of the disease were two male patients, 14 and 16 respectively, who had noted rectal bleeding, dysentery and painful defæcation at irregular intervals since early childhood.

One of these patients came to operation for relief of the serious depletion and secondary anæmia consequent upon prolonged bleeding and dysentery which had failed to respond to treatment by way of appendicostomy irrigations. A resection of the colon in conjunction with an end-to-end ileosigmoidostomy resulted in a good recovery and an eventual cure of the patient. Again as to the familial feature of the disease, the senior writer observed a female patient of 22 years whose symptoms began at the age of 18. When first seen she was in such a state of lowered resistance that an appendicostomy was done as a palliative measure and the patient subsequently discharged improved. She was readmitted, however, several months later with such a severe recurrence of symptoms that it was decided to subject her to radical treatment. A resection of the ascending and transverse colons with end-to-end suture of ileum to sigmoid was successfully performed, with the result that the patient was finally discharged under the "cured" classification. Some months later, this patient's father was admitted with a similar typical history and was also successfully operated upon for an intestinal malignancy in the vicinity of which typical scattered polyps were found.

These cases tend not only to suggest a composite clinical picture of polyposis of the colon but also furnish further justification for separating them into two disease entities on a symptomatic basis.

On the one hand, one constructs the picture of a child or youth, usually a male, varying in age from 10 to 18 or 20 years, who, for

Fig. 5. Low power photomicrograph of section of one of the polyps shown in Figure 4.

a considerable period of time, has been having intermittent hæmorrhages from the rectum associated with mucous dysentery, alternating with constipation, and a more or less apparent secondary anæmia. Between attacks, this patient is perfectly well but sooner or later progressive anæmia, depletion, and emaciation produce a condition demanding urgent interference; or, too frequently, an intestinal malignancy supervenes in these young subjects and surgery is called upon to play its limited rôle in staying the disease. Finally, to complete the picture, the gross pathological specimen, whether or not a frank malignancy, discloses the typical multiple, uniformly disseminated adenomatous polyps involving the mucous membrane of the large gut. It should be emphasized that this pathological change is, with very rare exceptions, limited to the large gut and rectum and especially should it be noted that the rectum is the favorite site of the tumors whatever may be its extent or location in the large gut above.

From the last, it follows that, except for the few rarities, one may establish or reject the diagnosis of the adolescent type of polyposis of the colon upon the findings of a rectal examination—digital or proctoscopic.

On the other hand, our clinical picture in the adult (acquired) variety varies somewhat from the above. This type being secondary to some antecedent disturbance, gives a picture which is colored by that condition. But, in general, the patient is in the middle or late period of life and has for a number of years complained of "colitis," which of late has been complicated by occasional moderate hæmorrhage from the rectum together with lower abdominal distress, "cramps" and "intestinal indigestion." The patient, not being acutely ill, is prone to be dilatory about seeking advice until loss of weight, anæmia, or the possible manifestations of malignant change place him, like patients with the adolescent type, in the realm of surgery.

The gross pathological picture is quite different from that of the adolescent group. At some point of the large gut there is evidence of acute or chronic mucous membrane irritation—traumatic erosions, ulcers of various types, tape worm (in one case studied) or stricture as the case may be and, adjacent thereto, a few scattered polyps of adenomatous structure. The tumors are limited in number and extent, showing a tendency to array themselves in the neighborhood of the primary focus wherever it may be located in the large gut (Fig. 3 and 4). So that we expect the adolescent, disseminated variety to present polyps in the rectum whatever may be its location or extent in the gut above. In the adult variety, however, because of the limited number of tumors, and their tendency to group themselves about the causative focus, a negative rectal finding is of little value in diagnosis in this group.

In view of the apparently close relationship of these polyps to intestinal malignancy and because of the light which it may throw on etiology, a histological study of the process is of particular interest. The tumors of polyposis are found to be made up of two essential elements, (1) the stalk or supporting framework of the tumor which is derived from and continuous with the submucous fibrous tissue, and (2) the epithelial covering of this framework which is continuous over the pedicle of the tumor with the normal epithelium lining the gut wall. And in this mucous membrane covering the tumor appear the changes which identify it.

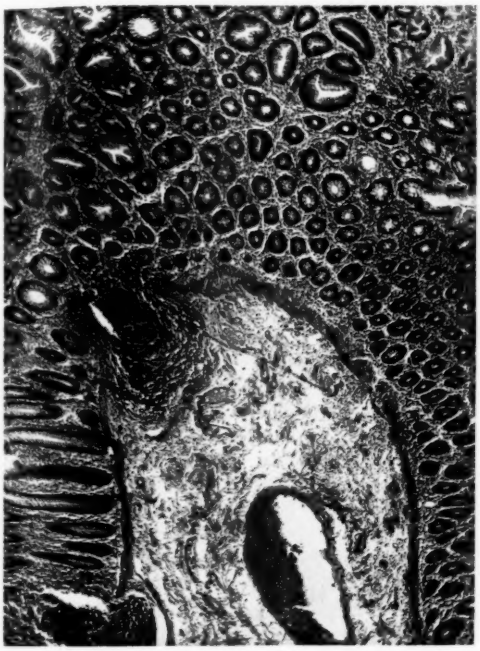

Fig. 6. High power photomicrograph of section shown in Figure 5.

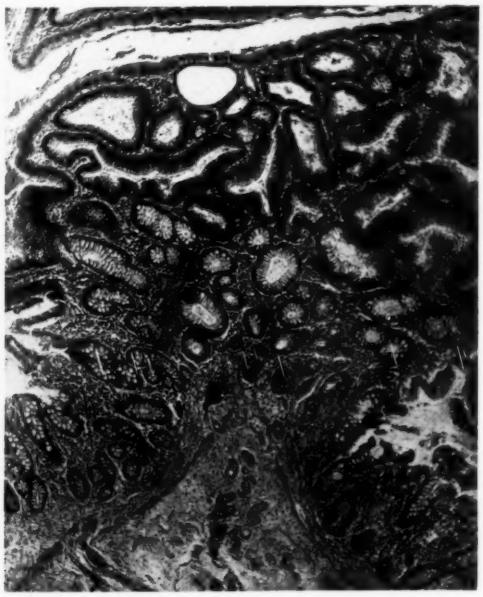

Fig. 7. Senior writer's case. High power photomicrograph of section from a polyp found in neighborhood of carcinoma of sigmoid.

Under the term of "inflammatory adenoid hyperplasia" Ewing describes this process as a diffuse thickening in which glands and stroma participate; there is hypertrophy and hyperplasia of glandular cells while the stroma shows lymphocytic infiltration with the formation of new stroma cells, blood and lymph vessels. The transition from this state of simple thickening to one of frank sessile or pedunculated tumor formation is a gradual one. It is assumed to be effected by the mechanical traction exerted by the ever moving intestinal contents upon the areas of thickening, infiltration and œdema thus eventually leading to their intrusion into the gut lumen as definite tumors.

One step further in our histology brings us to the most interesting and important feature of polyposis, viz., the relation of this disease to intestinal cancer. We have repeatedly been able, in a study of gross specimens in these cases, to demonstrate clearly, in the same gross specimen, all morphological gradations from simple polyps through early infiltrative tendencies up to frank and unquestioned adenocarcinoma. Followed histologically, the evidence is even more convincing. Nowhere, according to Ewing, can more clearly be demonstrated the logical transition from simple inflammatory hyperplasia to tumors which are morphologically, pathologically, and clinically adenomata and carcinomata.

Further details on the pathology of this condition are best referred, because of the limitations imposed by space, to the accompanying figures. Figure 4 is a photograph of a specimen of the cæcum and ascending colon removed from a female patient of 58 years following an intestinal obstruction. The specimen represents an ulcerating adenocarcinoma of the cæcum in the neighborhood of which are seen a few scattered sessile and pedunculated polyps from one of which sections were taken.

Figure 5 is a low power of section taken from one of the polyps in Figure 4. It shows

clearly the change from the normal mucous membrane lining the gut wall into that characteristic of the adenomatous structure of the tumor, viz. hypertrophy of glandular cells, increase and infiltration of stroma together with the fibrous stalk continuous with the submucous fibrous tissue. Owing to the plane of section, the relation of the stalk to the head of the tumor is not well shown. Figure 6 is a high power of the same section and brings out in one portion normal goblet cells while in another one may see the early evidence of hypertrophic and hyperplastic transition of the glandular cells into the picture typical of adenomatous structure. It is evident that this case falls into the adult group and that it illustrates one of the transitional possibilities of these so-called innocent tumors.

With these facts in hand, one is prone to regard any simple inflammatory hyperplasia or adenomatous polyp in this region as a potential source of danger to the patient. While theorizing on this phase of the subject, one cannot but be impressed by the assertion of Verse that most gastro-intestinal cancers arise from the simple adenoma which in turn is based upon an antecedent simple inflammatory hyperplasia of the mucous membrane. It does, therefore, seem logical to assume that almost all, if not all, of those intestinal cancers which we too often see in youth and early adult life, have had such a life history; in short, that they are merely end points in cases of polyposis of the colon. Finally, one may ask, what percentage of intestinal cancer in adults boasts of such an origin and follows such a course in the journey toward malignancy? Etiology seems almost to suggest itself as we study the life history of the process. The sequence of irritation, inflammation, reaction, mucous membrane hyperplasia, and polyp formation is readily acceptable.

Then also, in the colon, we have a mucous membrane coated viscus the function of which is to store a harsh food residue and, while so doing, to deprive this residue of the last traces of fluid content which has rendered its passage bland and non-irritating to the upper intestinal tract. In its dried state, this residue becomes an ideal medium to produce an endless, recurring series of minute traumata during its journey back and forth in response to peristalsis and antiperistalsis. Given a susceptible mucous membrane, response to such a series of stimuli takes the form of multiple areas of irritative hyperplasia involving first the mucosa and then the submucosa as the local mechanism produces the polypoid tumor.

It seems logical, therefore, in view of the pathology of adenomatous polyposis together with its almost invariable limitation to a segment of the gut burdened with a function of suggestive nature (Fig. 2) that we attribute this disease to chronic irritation. Whether or not this irritation is tuberculous, dysenteric, parasitic, mechanical, etc., is immaterial. The point to be emphasized is that adenomatous polyposis is a uniform, non-specific reaction (Fig. 3) to a great variety of inciting causes and the reaction is only variable (in degree, not in kind) as the intensity of the stimulus and the character of the soil varies. And in the adolescent type, where no gross associated evidence of irritation is demonstrable, we are forced to fall back on the theory of congenital predisposition and assume that these youths possess a preternaturally sensitive mucous coating of the intestinal tract which reacts to a minimum degree of irritation induced by the physiological functioning of the colon. The familial tendencies of this disease lend some support to this theory.

In approaching treatment, one may, with advantage, recall two features of polyposis of the colon which exercise an influence in the decision of the course to be followed: (1) the tendency of these tumors toward chronic hæmorrhage and diarrhœa predicating a serious depletion of the patient and (2) a malignancy incidence as high as 43 per cent of these cases (Soper's series) which is higher than that of any other benign process.

With these facts before us, it is obvious that removal of the tumors in their benign, adenomatous state is the ideal to be sought. Unfortunately, however, we are handicapped at the outset by the fact that we are dealing with a process the limits and extent of which we are unable to determine definitely by any means at our command. In the adult variety, it is true, the limitation in numbers and extent of the tumors to the region of the causative

lesion renders removal of some of the tumors through a proctoscope a practical possibility when the group is low down in the large gut or rectum. And although some of the group may be unapproachable even under the most favorable circumstances, the removal of as many as possible by this route is justified by the fact that the malignancy incidence will be, theoretically, reduced in proportion as the number of existing tumors is reduced.

A problem of different character presents itself in the disseminated variety of adolescence. Here the almost certain involvement of the whole or greater portion of the large gut with the possible extension, in a small percentage of cases, into the small gut for a variable distance, render efficient surgical approach a matter of some magnitude. In order to remove the menace of the polyp bearing area, one must consider the resection of the entire large gut and rectum only to find, possibly, that the limits of the process have not been reached and that involvement of the tract higher up determines an unaltered prognosis. In other words, eliminating the difficulties of such radical procedure, the problem is largely one of determining the extent of the process before operation. It is interesting in this connection to note that Carroll reports a case in which the peculiar thickening of the gut wall could be readily palpated after opening the abdomen and the extent of the process accurately determined by this means. We are unable to confirm this as a constant finding in these cases but, should it prove to be such, one of the most difficult problems—determination of the extent of involvement—would be solved. Lilienthal and Soper both report cases of successful removal of the colon to lower sigmoid for this disease and the senior writer secured a cure in a similar case several years ago by radical colectomy (cæcum, ascending, transverse and descending colon down to lower sigmoid) after repeated failures to produce results with an appendicostomy.

In the face of such difficulties, however, one naturally seeks a less radical method for the relief of the patient. Appendicostomy and cæcostomy have their adherents and, while these operations undoubtedly do offer some relief by reason of the rest which they afford the affected mucous membrane, a cure of the disease is inconceivable by this method.

Radium has, as usual, come to the rescue with reports of improvement of the symptoms and diminution in size of the tumors but none has been so bold as to report a cure by this means.

In brief then, one may sum up the present status of the treatment of this condition by saying that the only method which holds out any hope for cure in the disseminated variety of polyposis is one imposing upon the operator great technical difficulties, upon the patient great danger, and upon both the possibility that a successful operation may prove fruitless because the operator has been unable to determine accurately the extent of the process and has therefore left behind areas capable of transmitting all the original potentialities of the disease. There is some hope to be entertained that the development of X-ray experience along these lines will eliminate one of the obstacles to treatment by permitting a pre-operative determination of the extent of the tumor formation.

CONCLUSIONS

In conclusion, we would summarize our opinion of the present status of this disease as follows:

1. For purposes of standardization, it is suggested that the term "polyposis of the colon" be limited to designate an adenomatous hyperplasia of the intestinal mucous membrane as opposed to those polypoid tumors of the intestine which are histologically fibromata, myomata, etc.

2. Polyposis of the colon appears to be a uniform, non-specific mucous membrane reaction, variable only in degree to a chronic irritant in the presence of a preternaturally sensitive mucous membrane.

3. It is manifested grossly as scattered intralumenary tumors varying in size from a split pea to a grapefruit and has a specific predilection for the large gut and rectum which predilection increases in direct proportion as we proceed from the ileocæcal valve.

4. Two clinical types may be distinguished:

a. The adolescent variety, signalizing itself in early youth by chronic, recurring attacks

of intestinal hæmorrhage and diarrhœa and showing a distinct tendency to involve members of the same family.

b. An acquired variety first appearing in adult life in association with frank evidences of chronic traumatic and inflammatory lesions to which they are evidently secondary.

5. The two types have in common (a) the marked predilection for the large gut, (b) a malignancy incidence of more than 40 per cent and a tendency to chronic intestinal hæmorrhage and diarrhœa. They are dissimilar in that the one (adolescent) is widely disseminated, appears in almost countless numbers and shows no gross evidence of a causative lesion; while the other (adult) occurs in limited numbers and extent with, almost invariably, associated gross evidence of trauma, inflammation, or foreign body. The one is essentially a disease of early life while the other occurs in middle or late life, the cumulative result of prolonged irritation incident to years of functional activity of the gut.

6. In the presence of persistent and unexplained rectal bleeding and dysentery in early life, suspicion should be aroused of the existence of the adolescent form of polyposis of the colon; in adults, although a relatively less frequent cause, its consideration should not be neglected in a differential diagnosis of an obscure case of bleeding and dysentery.

7. Indications for treatment are the depleting hæmorrhage and diarrhœa and the high malignancy incidence. Non-radical, palliative treatment comprises cæcostomy, appendicostomy, irrigations, and radium therapy. Radical, effective treatment, excision of the polyp bearing area, is limited by technical difficulties and the inability to predict, pre-operatively, the extent of the process.

NOTE.—In the preparation of this paper, we are indebted to Drs. J. J. Moorehead, Thomas H. Russell, and John D. Stewart for the use of cases and specimens for study and to Dr. Paul Klemperer for invaluable suggestions and assistance in preparing specimens.

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PLASTIC SURGERY OF THE NOSE[1]

By GEORGE WARREN PIERCE, M.D., San Francisco, California

THERE is, at this time, a growing interest in plastic surgery of the nose. The work is difficult and mistakes, if made, are of course constantly exposed to public view. Patients usually expect perfection and are hard to please. It is well not to promise too much. To do these operations requires patience, judgment, and a refined technique.

In this paper I will discuss and show some cases of nose reconstruction, consider various deformities due to injury, disease, and congenital malformation and finally, introduce some suggestions regarding reduction of hump of the nose and also some apparatus of value.

Figure 1 shows a patient who was injured by an explosion of a compressed air tank over which he was working. A fragment of the metal tank tore away nearly half of the nose, and lacerated the upper eyelid. It was possible at the first repair to slide the tissue of the cheek so as to cover the upper portion of the nose but the remaining defect required a reconstruction operation, which demanded a supporting structure and epithelial lining as well as an epithelial covering. The first step therefore, was to implant in the cheek a strip of rib cartilage, 2 centimeters by 4 millimeters by 4 millimeters. The inner end of this strip rested in the stump of the ala. After 6 weeks a strip of skin bearing the rib cartilage on its under surface was turned over and the free end sutured into the tip of the nose. Other flaps from the nose were turned down to complete the epithelial lining. A forehead flap pedicled at the angular artery was then brought down to provide the covering. After 3 weeks the pedicle was severed and the unused tissue was returned to the forehead.

This case illustrates the surgical axiom that cavities such as the nasal cavity, when reconstructed, must be completely lined with epithelium. Regarding the epithelial covering it may be stated that forehead skin is the material of choice, despite the scarring, as the skin of the face differs in texture and appearance from skin of other parts of the body.

The defect shown in Figure 2 was treated in a somewhat different manner. This man was injured in a fall and a projecting stick tore away completely one-half his nose. At the first operation the remainder of the nose was sutured to the soft tissue of the cheek so that when he came to me several months later his nose was, as one might say, lying down on its side on his face. Before reconstruction was done, the defect was reconstituted as shown in Figure 2, and the wounds allowed to heal. This allowed an accurate estimate of the tissue loss to be made. After this operation the patient developed a glycosuria, was told of the dangers of further operation in the face of this condition, but he wished the nose completed and as the glycosuria cleared up under a diabetic diet the procedure was carried through with primary healing and no untoward symptoms. As the patient was partly bald, the use of scalp tissue was feasable. The epithelial lining in this case was provided first before the flap was brought down. A 5 centimeter square epithelial inlay by Esser's method was done beneath the scalp at a point to correspond with the extremity of the proposed flap. After 10 days the wax was removed and the next day the temporal artery pedicled flap was brought down and sutured into the bridge of the nose. The epithelial inlay was found to be completely successful both on the under surface of the scalp and over the galea. The uniform success of Esser's type of skin graft lends confidence to the surgeon, as it may almost always be relied upon for a complete take.

Twenty days later the pedicle was severed and the remainder of the flap returned, while the raw surface was sutured into the cheek. Because of the firmness of the scalp tissue, this nose in the alar region has maintained its contour and has not collapsed for want of cartilaginous or other support, and the inner surface has showed no contracture or distor-

[1]Read before the California State Medical Society, Los Angeles, May, 12, 1924.

Fig. 1. A patient injured by an explosion.

Fig. 3. A typical rhinophyma.

tion, such as is often feared in the use of the epithelial inlay. The last operation was completed about one year ago.

Figure 3 illustrates a typical rhinophyma. The second picture was taken 8 days after operation, and this fact explains the slightly roughened appearance of the bridge of the nose. Since then this area has smoothed down. The results from operating upon rhinophyma are spectacular, but the operation is easy as compared to the reconstruction work shown above. Some surgeons merely shave off the excess tissue, consisting of hypertrophied sebaceous glands and ducts with accompanying overgrowth of the connective tissue, and allow regeneration of skin to occur from the epithelium at the bottom of the ducts. This epithelialization is accomplished in a few days and it is evident that the tissue must not be removed too close to the nasal supporting structure, as this would destroy these islands of epithelial cells.

Often surgeons dissect out the gland bearing tissue, leaving the skin attached at the alar border, and return the skin flap to the nose. This skin, however, is discolored and porous. I treated the above case by dissecting off all the hypertrophied tissue, then using Esser's principle of Thiersch grafting with a Stent mold, covered the denuded area. One week later the mold was removed and healing was found to be complete. The added advantage of this method is that no change of dressing is required.

The etiology of the condition is not known: alcohol often is mentioned and this patient admitted the use of wine daily for many years. The accompanying acne cleared up with the use of unguentum hydrargyri ammoniati. X-ray has been mentioned as causing a regression of the hypertrophic process.

Figure 5 shows a pronounced saddle nose type. Wassermann reactions made in my office were all negative. After operation there was no reaction whatever. The nasal processes of the superior maxillæ had become markedly everted so that the nose was broadened as well as flattened. It was first necessary to fracture these inward by splitting through with a narrow chisel at the base. The incisions

Fig. 2. A patient injured in a fall.

a. *b.* *c.*

Fig. 4 *a* and *b*. A nose deflected to the side by an old fracture; *c* illustrates apparatus for maintaining a fractured nose. The metal cap splint for the upper teeth bears an angulated wire terminating in a vulcanite plate.

were made intranasally. Six weeks later the right eighth rib cartilage was removed, sufficient cartilage taken to restore the bridge and the remainder buried in the abdominal subcutaneous tissue for a reserve supply in case of failure. Over 2 years have elapsed since this operation and the contour of the nose remains unchanged. I prefer cartilage to bone or celluloid, as it is easily shaped, does not absorb so easily as bone, withstands infection better, and is not apt to be extruded as is celluloid.

The case shown in Figure 6, is that of a saddle nose type following a submucous resection of the septum. In this reconstruction eighth rib cartilage was also used, the same approach serving for introduction of the cartilage. The picture shown in Figure 6 shows a slight swelling of the base of the columella. This picture was taken a short time after healing.

I have noted in reviewing the case illustrations in the literature that the tendency, when cartilage is implanted for this deformity, is to extend it too high, even up to the glabellar region, obliterating the normal indentation at that point and spoiling an otherwise good profile. There is no need for this, as the cartilage can be readily shaped and should be accurately fitted. As Gillies advises, by cutting through the membranous septum and bringing the knife out at the base of the columella, a septal elevator may be easily passed up between the mucous membrane and the skin to prepare the cartilage bed. This procedure makes the passing of the

Fig. 5. A saddle nose type deformity and the result obtained from operation.

Fig. 6. A saddle nose following submucous resection of the septum.

Fig. 7*a*.

Fig. 7*b*.

Fig. 7*c*.

Fig. 8*a*.

Fig. 7. A patient who was kicked in the face by a horse when a boy.

cartilage through the nasal cavity unnecessary and therefore greatly lessens the danger of infection. Sometimes the loss of tissue in these cases is so great that it becomes necessary to free the structures within the nose. The denuded area must then be skin-grafted through an incision into the nose through the superior labiogingival sulcus. The method is fully outlined by Esser in his article, *Rhinoplasty without external skin incision*[1] (*Nasenplastik ohne Hautschnitt*).

The case shown in Figure 4, illustrates a nose which had been deflected to the side by an old fracture and which was straightened. The photographs also illustrate the simple and efficient apparatus which I have devised to maintain the correction. As one finds by experience, these old fractures after operation have a great tendency to cause the nose to revert to the original deformity. The splint, illustrated in detail in Figure 4*c*, has several advantages over head band splints, plaster or metal splints. It consists of a metal cap splint for the upper teeth, including the bicuspids, bearing a heavy wire ending in a vulcanite plate. The wire has a strong spring action and the pressure can be varied quickly by placing between the plate and nose varying thicknesses of felt. The advantages are comfort, small size and the absolute control of pressure. The pressure can be directed accurately, and potentially the spring is capable of any amount of pressure compatible

[1] Deutsche Ztschr. f. Chir., 1921, clxiv, 211.

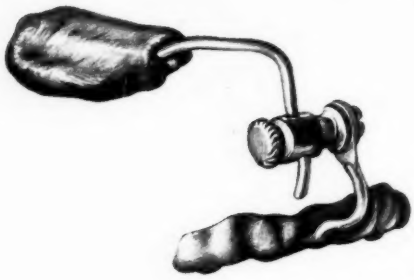

Fig. 8*b*.

Fig. 8. Complete atresia of the nasal airway of one side; *b* illustrates the apparatus used for the epithelial inlay in the nose. The metal cap splint for the upper teeth bears a wire ending in a binding post which carries a second wire terminating in a perforated plate covered with dental modelling wax.

with safety to the soft tissues. The nose may be easily inspected at any time by pulling back the spring. The splint is cemented to the teeth with dental cement.

This splint may be made with pressure arms on each side, if desired, to support a recently fractured nose.

As to the operative procedure in this type of case, I prefer to split the nasal bones or the nasal processes of the maxillæ with a narrow chisel introduced inside the nose through small incisions. The trauma is minimal and the control more accurate than when the nose is given a blow on the convex side. The latter method may merely crush in the nasal bone on that side, without correcting the deformity of the opposite side, and also one does not relish the fear of possible fracture of the

cribriform plate while carrying out the procedure.

The airway is generally distorted with displaced fracture of the nose and the reposition may clear it. Often, however, corrective work must be done on the septum.

Figure 7 shows a patient who was kicked in the face by a horse when he was a boy. The nasal bones and septum were badly fractured, causing blocking of one airway.

At operation the septum was resected and the airway was established, then the nasal bones were split with a chisel as in the preceding case and the nose was moved over.

These old fractures are often difficult of reposition and the deformity strongly tends to recur. The splint should be worn at least three weeks, and as it is not uncomfortable, there should be no hurry to remove it.

Figure 8 shows complete atresia of the nasal airway of one side due to injury. The scar involved the upper two thirds of the vestibule of the right side of the nose and entirely blocked the airway with the exception of a pin point opening. The deformity would of course recur if the scar were merely dissected out, therefore it followed that grafting of the denuded area with skin was indicated. To accomplish the grafting, I devised the apparatus illustrated. It consists of a cap splint on the upper teeth bearing a wire support much as in the apparatus designed for the case in Figure 4. The wire, however, ends below the nose in an eye into which is fitted a binding post of the type used on electrical instrument boards. The set screw holds in place another wire ending in a perforated plate. This construction gives an adjustment in two planes, the screw holding the binding post to the eye for one and the set screw holding the terminal wire for the other.

When the scar was dissected out, a model was made of the defect in dental modeling wax which had embedded in it the plate of the terminal wire. The wax was covered with a Thiersch graft and the wire now carrying the graft was inserted into the binding post, then into the nose and the graft held firmly against the raw surface by adjustment. After 10 days the splint was removed and the graft was found to be completely successful. The contracture in this case after 6 months has been negligible, though it might be well to follow up with a vulcanite support to the nasal airway, such a support to be carried by the binding post of the splint already worn by the patient. The splint is illustrated in detail in the drawing, Figure 8*b*.

Fig. 9. Patient before and shortly after operation for the removal of hump of the nose. The final result is improved over this as the postoperative swelling has subsided.

Figure 9 illustrates the now popular procedure of removal of hump of the nose. The result at the present time appears much better than shown in the picture which was taken very shortly after the operation when there still remained some evidence of the postoperative swelling.

Numerous operations have been devised for hump removal but I wish to suggest an operation which possesses several advantages. The approach is through an incision begun through the membranous septum and brought out through the base of the columella. The columella is then retracted upward and a septum elevator passed up between the walls of the septum and over the bridge to the root of the nose. As the operator is working in the midline the separation of the skin from the nasal bones is easily and quickly accomplished. Then with either a long bladed nasal speculum, or long thin bladed retractors, the area to be attacked may be brought into view.

The next step is the removal of a triangular section from the medial portion of the nasal bones with a narrow sharp chisel. As the greatest hump occurs at the lower end of the nasal bones the base of the triangle will fall at this point. The width of the base of the

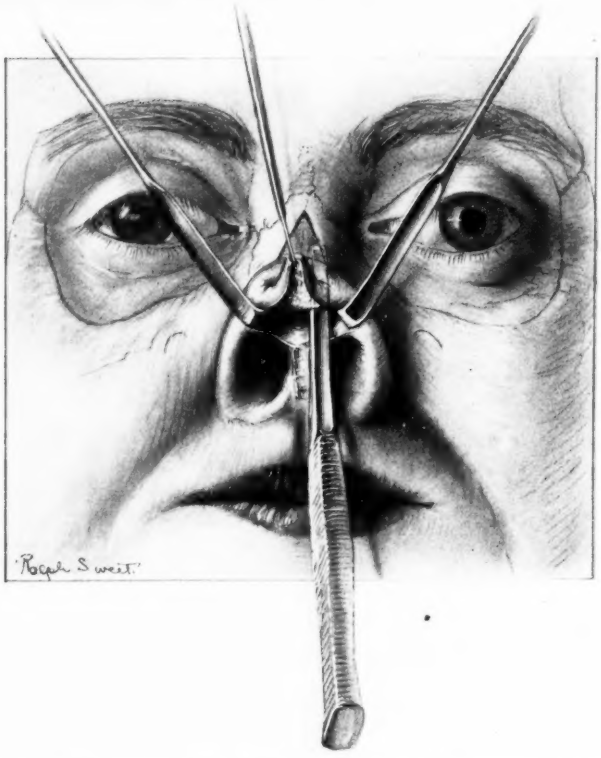

Fig. 10. Shows contour of the bones and the parts of instruments in phantom. The columella has been cut and retracted. The skin has been separated from the nasal bones and retractors inserted. The chisel is shown completing the removal of the triangular section of the nasal bones.

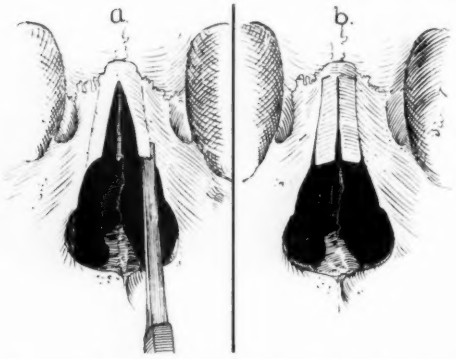

Fig. 11. *a* (left) shows the chisel splitting through the articulation of the nasal bone with the superior maxilla. *b* shows nasal bones after they have been fractured downward and inward to restore the bridge.

triangle varies according to the size of the hump. If necessary the upper border of the septum is chiseled off. Finally, the nasal bones are fractured inward by grasping them with a wide bladed hæmostat and the triangular bone defect is obliterated.

The periosteum need not be disturbed and shredded out either in separating the skin from over the bone or in cutting the bone with the sharp chisel, consequently there is little tendency to excess callus formation. The columella wound is then closed. The fractured bones are maintained in position by the use of two adhesive plaster pads, sticky side out, which are strapped on, or the splint illustrated in Figure 4, except that it would be double, would do even better.

DISADVANTAGES

The disadvantages of the rasping operation for removal of hump are:

1. The operation is applicable only to the narrow type, as with the wider nose the operation leaves a broad, flat bridge which is unsightly.

2. The shredding of the periosteum and the scattering of bone cells tend to excess callus and return or even exaggeration of the deformity.

3. There is danger of tearing the nasal mucous membrane.

4. The particles of bone which remain favor infection and may act as foreign bodies.

5. In working through an incision within the nasal cavity infection is more apt to occur.

ADVANTAGES

The advantages of the operation illustrated are:

1. It is applicable to all types of humped nose as the bridge remains narrow, and the reduction of the hump may be accomplished accurately.

2. There is little if any tendency to excess callus.

3. The nasal mucous membrane may be avoided.

4. The work is at all times under the operator's eye.

5. By avoiding the nasal cavities liability to infection is greatly reduced. The technique of the operation is shown in Figures 10 and 11 *a* and *b*.

EXTRADURAL LIPOSARCOMA OF THE SPINAL CANAL

A Clinical and Pathological Report[1]

By JOHN A. CALDWELL, M.D., F.A.C.S., Cincinnati
AND
M. M. ZINNINGER, M.D., Cincinnati
Ransohoff Fellow in Surgery 1923-1924

UNDER the general description of liposarcoma, one finds, in the literature, descriptions of several types of tumors: (1) lipomyxosarcoma and allied tumors, (2) lipomata with areas of sarcomatous degeneration, and (3) true liposarcomata. Of these three, the first type is apparently the most common. The type was first described by Virchow (12, 13) in 1857. He described a number of cases, and in 1865 referred to them under the name "myxoma lipomatodes malignum." For many years these tumors were supposed to represent the type of malignant fat tumors, and are still so considered by some. In 1916, Robertson (8) collected 50 cases from the literature, and added the description of 1 case of his own. He clearly recognized the histological character of these tumors, and suggested that they be designated by the term "lipoma myxomatodes."

These tumors arise wherever lipomata are found, but the reports show that the majority have their origin either in the retroperitoneal tissues or in the fatty tissues in the intermuscular septa, particularly in the buttocks and thighs. They grow relatively slowly and tend to be encapsulated, though they sometimes burst through their capsule. There is a distinct tendency toward local recurrence, and metastasis is not rare. Of the 51 cases reported by Robertson, 23 were benign, 17 malignant, and in 11 there was a question as to malignancy. Some of them show well marked, fully developed sarcomatous nodules in their substance, and it was this tissue alone which had metastasized in some of the cases.

Tumors of this category show three histological elements: (1) fat, usually adult fatty tissue; (2) an embryonic type of fibroblast, the cells being stellate in shape; (3) a gelatinous, semifluid material which has the physical properties and staining reactions of mucin.

This last named element is the most essential feature of these tumors, and is the substance which gives the name myxoma to the group. It lies in the interstices between the stellate fibroblasts, and is also collected into larger and smaller spaces. The relationship between the fat and the mucoid material is still an obscure one. It has been suggested (1) that the mucoid is degenerated fat tissue, (2) that the fat is a product of degenerated mucoid tissue, and (3) that the fat and mucoid arise simultaneously, side by side, from the same mother cells. The relationship, at any rate, appears to be a close one, in these tumors. Other considerations, however, throw some doubt on the essential connection of fat and mucoid. The myxomatous tissue occurs in situations free from fat as in the pure myxomata and in the myxosarcomata; in these situations it is always closely related to the stellate type of fibroblast; in the myxolipomata it is associated with adult fat cells. For these reasons the term lipomyxosarcoma seems an undesirable one, for liposarcoma should be reserved to designate tumors made up of embryonal fat cells.

The second type of tumor found under the heading of liposarcoma, is that in which an area of sarcoma is found in the substance of a lipoma. These are not true liposarcomata, in that the tumor does not arise from the fatty tissue, but from the fibrous tissue stroma. They are represented histologically, as a rule, by spindle cell sarcoma, such as might arise from such a connective tissue structure. This is a relatively common finding in recurrent lipomata. They have about the same clinical course and prognosis as spindle cell sarcomata elsewhere. In connection with these tumors, it is necessary to point out another

[1]From the Surgical Department, University of Cincinnati and the Cincinnati General Hospital.

type of so-called liposarcoma, the type arising in or alongside of the kidney. Some of these belong to the group of lipoma myxomatodes malignum, some are true liposarcomata, while others are apparently hypernephromata mistaken for sarcomata.

The third type, or true liposarcoma was apparently first recognized by v. Rindfleisch (7), who stated that "the lipomatous sarcoma (sarcoma lipomatodes) is one of several varieties of lymph-glandular sarcoma . . . which shows us the tendency of the cells to change themselves into fat cells by fatty infiltration. This change always takes place in only a limited number of the elements, but the elements so changed are so striking and so large that one might easily suppose that the majority of the sarcoma cells have been changed into fatty cells. In spite of the similarity to fatty tissue, confusion with lipoma is prevented by the irregularity of the infiltration, and by the fact that there are found very large and very small cells side by side, and never uniting to drops."

Borst (1) refers to these tumors as follows: "By the term lipoma sarcomatosum or liposarcoma, one understands (according to v. Rindfleisch) a sarcomatous tumor of round cells, in which the sarcoma elements have the tendency to become infiltrated with fat. The fat infiltration is very irregular, and practically never leads to the formation of typical fat cells; in many cells the fat infiltration is quite extensive, in others only the smallest and finest fat droplets are found in the protoplasm of the round cells, while still others carry great globules of oil, usually in cells in which the nucleus is pushed to the side and flattened out. For this reason the size of the sarcoma elements is very variable. It is characteristic that the droplets in the sarcoma cells are not united into larger drops of oil. Such lipomata arise from subcutaneous and intermuscular fatty tissue. Those sarcomata, which owe their fatty content to the fact that they grow in fatty tissue or in a lipoma, must not be called liposarcomata. One must also take pains to differentiate fatty degeneration which is present in all sorts of sarcomata, from the fat infiltration described above."

A number of tumors of this group have been reported, and from these records it seems that the following description of the essential characteristics may be given. Liposarcomata arise in the same situations as lipomata, principally in retroperitoneal and in intermuscular fatty tissue. They tend to be encapsulated, but may extend locally and even metastasize. They often are lobulated like lipomata, and although the cut surface shows in general the appearance of a lipoma, there is usually a more granular texture, suggestive of the abundant cellular content. Histologically they consist of round to somewhat oval cells, with sharply outlined, centrally placed nuclei, and slightly granular but more or less homogeneous, acidophilic protoplasm. The cells differ greatly in size due to the varying fat content. In the small ones with the homogeneous, slightly granular cytoplasm there is no fat, or fat only in the smallest of vacuoles. In the larger cells, the vacuoles are larger but fewer in number, while the largest cells consist of several large vacuoles, separated by the finest protoplasmic strands, often with the nucleus displaced to an eccentric position, and occasionally somewhat flattened out. With suitable stains it can be shown that these vacuoles have been filled with fat, generally neutral fat. The relationship of these fat containing cells to normal or adult fat cells is not entirely clear, but they are presumably embryonic, storing up fat in their bodies in an attempt to differentiate into mature or adult fat cells.

No attempt has been made to collect a series of all cases of this type reported in the literature. Delachanal (4) in 1910 reported 3 cases personally examined, with synopses of 12 other cases collected from reports, many of them doubtful liposarcomata, and gives a number of references to still more doubtful cases. Schramm (10) also in 1910 reports on the pathological histology of 1 case, and reviews reports of 6 others, which he discards as improbable liposarcomata. Comolle (2) in 1921 reported 2 cases of undoubted liposarcomata. Dr. Mallory has sent me a section of one case of liposarcoma, the only one he has seen.[1] Dr. Ewing has seen but 2 such cases.[1]

[1]Personal communication.

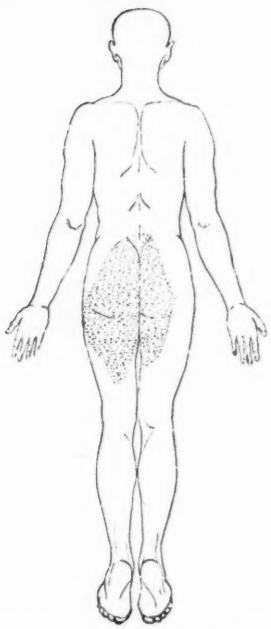

Fig. 1. Area of anæsthesia observed January 20, 1923.

Clinical report by John A. Caldwell:

The patient, G 8681, a steamboat captain, 69 years of age, and of very rugged and vigorous physique, was referred to me by J. E. T. Kennedy. His past history furnished nothing bearing on his present illness. The patient fixed the onset of his complaint definitely as December 15, 1922, when he felt a severe pain in his left sacro-iliac region, which did not yield to simple remedies and was unrelieved by change of posture. After several days he noticed that he was numb at the end of the coccyx. On January 1, 1923, he was unable to void, and from that date until the day of operation he required catheterization.

On January 4, 1923, he lost control of his rectal sphincter. On January 5, he complained of excruciating pain in the left thigh, radiating down the course of the sciatic nerve and through the posterolateral aspect of the left thigh and calf. These attacks recurred frequently and were so severe that they could not be relieved by morphine.

He was seen on January 19, by Charles E. Kiely, who made a diagnosis of probable tumor of the cauda equina, and recommended surgical consultation. A spinal puncture was made, and fluid obtained which was contaminated with blood. A blood Wassermann was negative.

I saw him on January 20, and made the following findings: No muscular atrophy or paralysis. Anæsthesia, irregular, saddle shaped, of greater area on the left side, was complete to pain, temperature, and touch (see diagram, Fig. 1). Reflexes: Upper abdominal, present; lower abdominal, absent; cremasteric, absent; patellar, present and more active on the right; Achilles, absent; Babinski, absent.

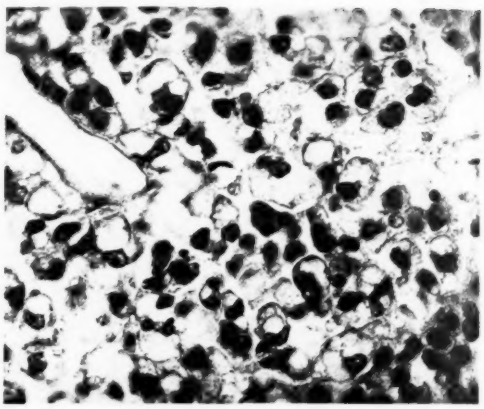

Fig. 2. Photomicrograph of a typical section of the tumor. × 600. The white structure in the left upper corner is a spicule of bone. The vacuoles show very well in some of the cells.

I made a diagnosis of tumor of the cauda equina, and advised exploration.

The X-ray plate was interpreted as negative, but subsequent examination of the roentgenogram revealed some involvement of the 3rd lumbar body.

Operation, January 23, 1923. The incision was made over the lumbar spines and upper sacrum. The laminæ of the third, fourth and fifth lumbar, and first and second sacral vertebræ were removed. The dural sac was found uniformly distended, firm and not pulsating. When the cauda was exposed, the roots were found adherent to each other, and imbedded in a mass which pressed backward through the anterior dural wall. This mass was found to be of fatty consistency, containing broken down bone, and attempts to ascertain its extent resulted in expressing a centrally located, semi-fluid, yellow matter. The mass seemed to involve the sacrum and the bodies of the fourth and fifth lumbar vertebræ. It was obvious that no sort of removal of the mass could be made that would give symptomatic relief. Troublesome bleeding was encountered in attempting to separate the branches of the cauda from the mass, and was controlled by placing muscle grafts over the bleeding points. The dura was partially closed with silk. In the sacral portion of the wound, attempts to release the dura from the tumor had caused so much shredding of that membrane that closure was impossible. The operation was quite tedious, but the patient left the table in excellent condition.

The following morning the dressings were saturated with cerebrospinal fluid, and in the afternoon

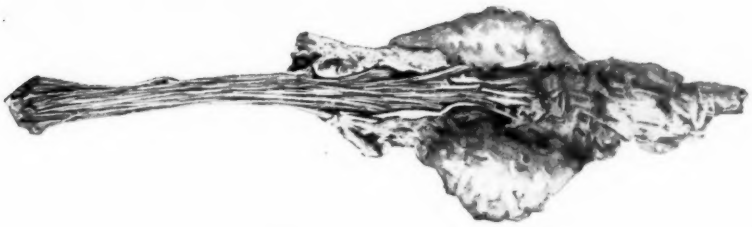

Fig. 3. Specimen after fixation.

the temperature reached 104.6. It continued high with but slight remissions until death on January 26. The cause of death was ascertained to have been due to infection of the operative field and cerebrospinal fluid.

Necropsy. Permission was obtained to explore the field of operation only. When the stitches were removed from the operative wound, there was a discharge of cloudy seropurulent fluid. When the deep stitches were removed, the muscles separated, and the surfaces were found covered with purulent exudate. The laminæ of all the lumbar vertebræ were removed. At the level of the twelfth dorsal the cord was cut and lifted out of the dural canal, the nerves being cut at their points of exit through the dura. At the fifth lumbar vertebra the dura was cut, and was lifted from the spinal canal with the cauda and as much of the tumor as could be obtained. This tumor was found growing from the fifth lumbar and first sacral, was firmly adherent to the dura and was pressing it forward. The roots of the cauda were firmly agglutinated and the individual roots not recognizable. By chiseling and exploring the bone, it was found that the tumor mass invaded the greater part of the fifth lumbar and first sacral vertebræ. The mass at the center was semifluid in consistency, and in its firmer portions resembled cerebral tissue, but the outer margins where it invaded the bone, rendered the bone friable and spongy. The body of the third lumbar vertebra was occupied by a similar mass, which did not impinge on the spinal canal, and was not contiguous with the tumor mass below. Smears from the exudate on the cut muscle and from the turbid fluid showed many staphylococci.

The striking clinical features in this case are the following.

1. Definitely fixed onset of the condition (the patient was positive in his statements that he had had no discomfort before December 15, 1922).

2. An extensive malignant tumor, presumably originating in the fatty tissue of the lumbar spine, was symptomless until it encroached on the cauda.

3. Invasion of the cauda was manifested successively by pain, involvement of the nerve supply to the bladder, and rectum, and cutaneous anæsthesia.

Pathological report by M. M. Zinninger. The gross specimen was sent to the laboratory of surgical pathology, to be preserved as a museum specimen. It came to the laboratory in Kaiserling I solution. It consisted of the terminal 6 inches of the cord and about 4 inches of the cauda equina. At the upper end of the cauda lay an irregular tumor, attached to the outer surface of the dura, and enclosing the emergent nerves. It had evidently been removed with difficulty and had been cut through in many places. The tumor measured 5 by 4 by 3 centimeters. There was no sign of encapsulation. It was very soft, almost as soft as brain tissue. The cut surface was somewhat granular, in addition to being oily or greasy. It was dirty, greenish-yellow in color, irregularly streaked and spotted with reddish and brownish areas of extravasated blood. No definite structure could be made out. Unevenly distributed through it were irregular, reddish spicules of cancellous bone, varying from 1 to 2 up to 5 to 6 millimeters in length. The tumor was entirely extradural, but adherent to the dura and to several of the nerve roots, which could, however, be easily freed from it. The inner surface of the dura at the level of the tumor was perfectly smooth, though at the lower pole of the specimen there was so much shredding of the tissue that the exact relations of tumor to dura could not be determined. At its lower end, the tumor faded imperceptibly into normal fatty tissue which was also infiltrated with extravasated blood so that its appearance was not a great deal unlike that of the tumor.

On account of the position of the tumor, and the microscopic appearance of large, irregular, vacuolated cells, it was thought at first to be a chordoma. However, its fatty appearance, and its close association with fatty tissue suggested another possibility, that it was a liposarcoma. The tissue was formalin fixed, embedded in celloidin, and the sections stained with hæmatoxylin and eosin. It was necessary to decalcify one of the blocks on account of the presence of large spicules of bone.

The sections stained with hæmatoxylin and eosin showed a very cellular structure, the cells closely packed one against another. There was no connective tissue stroma except that which immediately surrounded the arterioles and capillaries, which were quite abundant, and seemed to be the only connective tissue structures present. The arrangement of the blood vessels gave the merest semblance of a lobulated structure. There was much extravasated blood throughout all the sections, small areas of necrosis, and small spicules of dead or dying bone. The cells were round to somewhat oval in shape, and varied greatly in size. None of them was small, and the largest were enormous. The nuclei were centrally placed, except in the very large cells, where they were eccentric. They had a very sharp outline, relatively scant chromatin, with usually a single large nucleolus. No well developed mitotic figures were present, but in some of the smaller cells, the chromatin was piled up as if there was rather active division taking place. The cytoplasm stained a faint pinkish color. In the smaller cells it was almost homogeneous, but slightly granular. In the larger there were present several to many small vacuoles, separated by strands of reddish protoplasm. In the largest, there were 3 to 6 large vacuoles, separated by a fine network of protoplasm. In these cells the nucleus was pushed to the side, and, in a few, was actually flattened out. A very few cells resembled adult fat cells. Around the edges of one section were found some areas of normal, adult fatty tissue. At some of these the tumor seemed to be invading the fat, but the presence here of extravasated blood and necrosis made it difficult to interpret the resulting picture. The bony spicules scattered irregularly through the section were evidently being invaded and destroyed by the tumor.

Attempts to stain mucin in the sections have been unsuccessful, mucicarmine, muchæmatin, polychrome methylene blue, etc, giving not the slightest suggestion of a specific staining reaction. Scharlach R by the method of Herxheimer in frozen sections, gave a beautiful picture, showing that the vacuoles described in the hæmatoxylin–eosin sections were filled with fat droplets which stained a reddish orange color. In addition to the fat in the cells, there were some larger globules in the interstices between the cells, not an unexpected finding considering the proximity of the tumor to normal fatty tissue.

It seems clear that the tumor described belongs to the group of true liposarcoma in the sense of von Rindfleisch and Borst, and of modern writers on the subject, i.e., a tumor made up of embryonal fat cells. The presence of rather actively dividing nuclei, as evidenced by the piling up of chromatin, and the obvious invasive and destructive character of its growth, leave no doubt as to its malignancy. The rapid development of the clinical symptoms gives striking testimony as to the rapidity of its growth. The tumor mass in the 3rd lumbar vertebra may be considered as a metastasis, but, unfortunately, in the absence of a complete postmortem examination the presence of other metastases remains unestablished. We have been unable to find a record of such a similar destructive growth in a liposarcoma, nor have we been able to find a report of a liposarcoma in the position of this one. There is abundance of fat in the spinal canal, and lipomata have been reported there. The presence of lipomata at this level in connection with spina bifida occulta is well recognized. A possible liposarcoma of the spinal cord itself was reported many years ago (11), but from the description it seems unlikely that it was a true liposarcoma.

I wish to express my thanks to N. C. Foote of the Department of Pathology for his interest in this case, for his kind advice and suggestions, and also for his kindness in making a photomicrograph of a section of the tumor.

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A METHOD FOR THE LOCALIZATION OF BRAIN TUMORS—THE PINEAL SHIFT[1]

By HOWARD C. NAFFZIGER, San Francisco, California
From the Division of Neurological Surgery, University of California Medical School

THE pineal shift as determined by X-ray examination will frequently localize a brain tumor. This method has been of great value in confirming opinions based on neurological examination, and it alone has frequently made the diagnosis possible.

It has also resulted in widening the range of diagnosis by X-ray examination. Formerly the minority of cases of intracranial pressure yielded X-ray evidence of the location of the lesion. Diagnostic information of a localizing character can now be obtained in the majority.

The percentage of brain tumors and of other gross intracranial lesions which cannot be localized by clinical methods of examination alone is considerable. It varies greatly if one considers the length of time the case is studied. It has been estimated at various figures. Dandy has made the statement that only 50 per cent of the tumors could be located with accuracy sufficient to guide the surgeon. This is probably a low figure for the clinical neurologist. Others have given much smaller percentages, but it seems reasonable to suppose that in a short period of observation there will remain something like 20 per cent which cannot be localized. In these, additional diagnostic methods are required. We have found that, by simple and safe means, the number in this small and difficult group can be reduced.

It is a matter of common observation at autopsy that the portion of the brain in which a growth is situated increases greatly in volume. This is not only due to the presence of the lesion itself but to an increase in the fluid content of this hemisphere. To a less extent the brain as a whole becomes œdematous. In such conditions it is not uncommon to find the affected hemisphere even one-third larger than the opposite one (Fig. 1). The dislocation of the falx and of all mid-line structures to one side and the accompanying distortion are very striking.

Shueller (1) refers briefly to the displacement of the shadow of the pineal gland due to pressure from tumor or traction on the part of a brain scar. He quotes a case of right hemiplegia, presumably from circulatory causes, in which the pineal shadow was displaced to the left. He concludes that there was contraction of the left hemisphere perhaps from softening and that the pineal was drawn to that side from scar. No autopsy findings or confirmation of the diagnosis were mentioned.

Under the constantly improving methods of roentgenography and particularly with the use of the Bucky diaphragm, greater definition of structures is being obtained and more details are visible. Calcification in the pineal gland which occurs under normal conditions in a large percentage of individuals is often noted in lateral views of the skull. It occurred to us that the position of this structure might be of diagnostic value if variations in it occurred with gross lesions. The pineal shadow is seldom seen in the anteroposterior or postero-anterior view of the skull. This is chiefly owing to the position in which the film is taken. Ordinarily the pineal shadow is obscured by the accessory sinuses. When, however, the direction of the ray is parallel to a line drawn between the external canthus of the eye and the external auditory meatus, the pineal shadow is seen to be projected well above the sinuses. We have found it more advantageous to have the patient in a face up position with the occiput against the film, as the pineal gland is somewhat closer to the back of the head than to the front. If with the head in this position (Fig. 2) the tube is carefully centered so that the central rays pass along the mid-sagittal plane, one can readily determine the relation of the pineal shadow to this plane. Developmentally the pineal is a true mid-line structure. There is little to indicate that its calcification has any pathological significance. A study of a large

[1] Presented in part before the meeting of the Nevada State Medical Society, September 13, 1924.

Fig. 1. Frontal section of brain showing a metastatic tumor with fresh hæmorrhage into it. Note the great increase in volume of this hemisphere and the dislocation of the mid-line to the opposite side.

number of normals has shown that the shadow lies exactly in the mid-line (Fig. 3).

In all conditions associated with intracranial pressure and in the presence of a calcified pineal, our cases have been studied from films taken as described. It has been shown in the presence of intracranial pressure that where the lesion is located in the right cerebral hemisphere the pineal shadow has been shifted from its position in the mid-line toward the opposite side. The degree of pineal shift, as we have termed it, varies considerably. A common shift is a distance

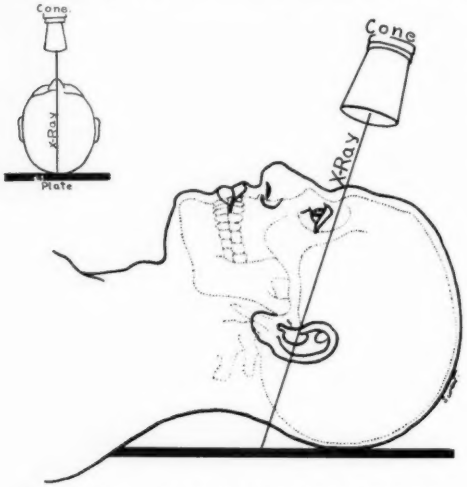

Fig. 2. Diagram showing the position of the head.

Fig. 3. Normal skull. A true postero-anterior projection showing the calcified pineal in the mid-line just above the frontal sinuses.

of about 1 centimeter (Fig. 4). We have, however, found it displaced away from the lesion for a distance of 2.5 to 3 centimeters (Fig. 5). When the gross lesion is on the left side, the pineal shift occurs to the right. The shift has been present whether the growth has been frontal, parietal, or occipital. With lesions of the posterior fossa or base which produce a high degree of intracranial pressure from an internal hydrocephalus, the lateral ventricles, both right and left, have been uniformly dilated. The pressure is so uniformly distributed, that the mid-line structures have not been distorted and the pineal retains its true mid-line position. No shift occurs. These experiences have been true in 15 cases proved by operation or autopsy.

ILLUSTRATIVE CASES

The following illustrate the pineal shift in cases with obvious signs of localization:

Case 1. Pineal shift away from tumor (Fig. 4). E. W. University of California Hospital. No. 46667.

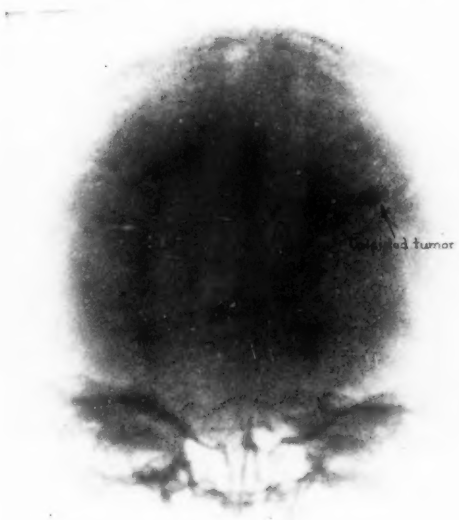

Fig. 4. Showing pineal shift away from the side of a calcified tumor.

Fig. 5. Marked shift of the pineal shadow.

Female, age 37. Diagnosis: glioma right frontal—cystic partly calcified. Cyst evacuation. This patient had a proved cystic glioma of the right frontal region. The roentgenogram is of interest in showing both the tumor partly calcified and the pineal shift toward the opposite side.

CASE 2. Marked shift of pineal to right with left temporoparietal tumor (Fig. 5). M. L. J. University of California Hospital. No. 46035. Female, age 55. Brain tumor left parietal, not proved. Patient entered hospital with a right hemiplegia and complete aphasia of gradual onset over several months. Choked discs and stupor were present. Neurological examination showed no involvement of cranial nerves, but the usual findings of a hemiplegia. Localization of lesion presented no problem but marked shift of pineal shadow to right was of interest.

CASE 3. No shift of pineal shadow with internal hydrocephalus. F. V. University of California Hospital. No. 45892. Female, age 27. Acoustic neuroma proved. Tumor removal. This patient gave the characteristic chronologic sequence of symptoms with typical findings. The fifth and seventh nerves were involved along with the eighth. The cerebellar signs were pronounced and a high degree of intracranial pressure evidenced by highly choked discs. Marked internal hydrocephalus was proved by ventricular puncture.

The X-ray report noted—Pineal shadow in midline. No shift.

As an indication of the determining value of the method, the following is one instance.

CASE 4. E. F. Patient seen in consultation, May 22, 1924 with Drs. Fred Fairchild and Harbinson at the Woodland Sanitarium, Woodland, California. The patient was in stupor with slightly swollen optic discs and evidence of intracranial pressure. From the history his condition was presumably due to brain abscess. His state prevented perimetric fields, sensory tests, etc. There was a story of difficulty in the use of the left hand. It proved impossible for us to determine by examination of the patient whether we were dealing with an involvement of tracts in the right cerebral hemisphere or with a left cerebellar lesion. The roentgenograms previously taken in the usual manner gave no localizing information. It was noted, however, that these plates showed a calcified pineal. The patient was returned to the X-ray room. Films were taken in the manner here described, and it was found that the pineal shadow was in the exact midplane. Its position argued against a right cerebral lesion and for an internal hydrocephalus. With this aid a diagnosis of a left cerebellar abscess was made, found at operation and evacuated with recovery.

Reviews of a considerable number of X-ray plates have been undertaken with a view to determining in just what percentage of individuals the pineal gland is calcified. Various factors affect these figures, principally the age of the patient and the character of the

roentgenogram itself. The percentage of calcified pineals is, of course, much decreased if any large number of children is included. In patients of greater age, a larger percentage of positives is obtained. The following figures are based on a study of 215 consecutive cases:

		Per cent
Total skulls	215	....
Pineal calcified in	97	45
In 45 cases under 20 years of age, 7 were calcified, or		15.5
In 96 cases over 20 years of age, 56 were calcified, or		58

In general it has been found that in something like 50 per cent of cases, the pineal gland is sufficiently calcified to be of diagnostic value. The two essentials for the use of this method of diagnosis are of course, first, that there is sufficient pineal calcification to cast a shadow; and, second, that intracranial pressure is present. It is doubtful whether any considerable dislocation of the gland will occur if there is not sufficient pressure to give intracranial signs. If, however, intracranial pressure is present as indicated by papillitis or choked discs, or possibly in more acute cases by an actual rise in the spinal manometer reading, it offers great help. Subacute and acute conditions such as abscesses and hæmorrhages, have given the characteristic shift. Stereoscopic plates are of decided help and permit one, without any great difficulty, to recognize even slight dislocation of the shadow from the mid-line. Studies are now being made from lateral views of the skull to determine the normal position of the gland in horizontal and vertical planes with reference to the skull as a whole. It is hoped that further observation and study may enable us so to standardize the lateral roentgenograms of the skull that we can detect an anterior or posterior or an up and down deviation of the gland from its normal position. It is also possible that if such conditions as transient œdema or swelling of one-half of the brain occurs, this method may be of value in detecting it.

Inasmuch as about 50 per cent of all cases showed calcified pineals and possibly 20 per cent or more of the intracranial gross lesions cannot be localized by clinical methods alone, this method will give us localizing information in one-half of these.

CONCLUSIONS

When the pineal gland is calcified (in about 50 per cent of all skulls), its position gives diagnostic information in cases *with intracranial pressure.* The shift has been found with brain tumors, brain abscess, and in certain cases of brain swelling consequent upon a vascular block.

A position of the pineal to the right of the mid-sagittal plane indicates a left sided lesion above the tentorium.

A position of the pineal to the left of the mid-sagittal plane indicates a right sided lesion above the tentorium.

A position of the pineal in the mid-sagittal plane in the presence of intracranial pressure indicates equal pressure on the two sides. In the chronic form of intracranial pressure as due to tumor or abscess this means internal hydrocephalus. This has been found occurring in lesions of the posterior fossa and distortion of the third and fourth ventricles.

In the roentgenological development of this method and the observations on most of the proved cases, I desire particularly to thank Howard Ruggles and Lloyd Bryan for their interest and aid. For additional observations and statistics on pineal calcification, I am indebted to James Thom, J. Rehfisch, and A. E. Elliott.

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A PLAN FOR THE EARLY DIAGNOSIS AND MANAGEMENT OF PRIMARY PAPILLOMA OF THE URETER AND KIDNEY PELVIS

A Case Report of Each

By ROBERT V. DAY, M.D., F.A.C.S., FRED D. FAIRCHILD, M.D. and HARRY W. MARTIN, M.D.,
Los Angeles

PRIMARY tumors of the kidney pelvis and especially of the ureter are very rare. Following back the literature to the first cases and up to the time the catheterizing cystoscope was perfected, one finds that most were discovered at necropsy. The classic theses of Albarran in 1902 and 1912, and also those of Israel, have given great impetus to the study of these diseases.

OCCURRENCE

Albarran (1) in 1902 compiled 10 case reports of tumors of the ureter—2 of them his own. In 1921 Judd and Struthers (8) reported a carcinoma, the only 1 occurring in the Mayo Clinic up to that time or since (17), and collected from the literature 25 others. Aschner (2), in 1922, compiled a total of 48 case reports, including various histological types. Kretschmer (9), in 1924, collected 34, definitely malignant on section, making altogether, with the authors' case, 56, 34 of which were papillomata. No other clinic or observer, except Albarran, Suter, and Beer, has reported more than 1 case of primary ureteral neoplasm.

Primary papilloma of the kidney pelvis is a little less rare. In 1920 McCown (11) compiled 48 cases, 10 American and 38 foreign. Spiess (18) in 1915, in an extensive review, gave abstracts of 76 cases of papilloma and 44 solid tumors of the pelvis. Gilbert Thomas (20) compiled 248 cases of tumors of the kidney pelvis or ureter; a large percentage of Thomas' were metastatic from primary growths in the bladder, prostate, or other organs, and the collection is not limited to any type of neoplasm. Two-thirds of these were previous to 1908, and mostly necropsy cases. Approximately 16 additional cases of papilloma have been described in the American journals by Thomas (20), Beer (3), Stevens (19), Miller and Herbst(13), Ockerblad (15), Colston (4), Landon and Alter (10), and from the Mayo Clinic (17) since McCown (11) reported 48, totaling from all sources, after unscrambling the duplications, more than 100, over 25 of them American. Doubtless scores have gone unreported and many missed altogether. For example, one of our colleagues in Los Angeles (Rosenkranz) did not report his case (number 144–077 Los Angeles General Hospital).

ETIOLOGY

In a few cases stone seems to have been a factor in the causation of papillomata in both the ureter and kidney pelvis. Leucoplakia or long standing irritation and inflammation are at times probably factors. The patients at other times have been workers in dyes and chemicals. Goebel (7) reported cases apparently the result of bilharzia organisms. One of us (Day, 6) has reported a case of a young man reared in South Africa who came to the hospital for acute retention of urine due to blood clots in the bladder. Routine examination of the urine disclosed the ova of bilharzia. The cystoscopic picture was that of a classical benign papilloma near the left ureteral meatus. Bleeding from the papilloma was observed and the papilloma was destroyed by fulguration at that sitting, the patient subsequently being treated by intravenous injections of tartar emetic with a clinical cure. Catheterization of the ureter later disclosed no ova or sign of involvement higher up.

MALIGNANCY

Papillomata predominate numerically over solid growths in both the ureter and kidney pelvis. They are distinctive in that they are easily transplanted by prolonged contact or inoculation to other portions of the mucosa. Hence, whenever a papilloma exists in any

Fig. 1. Roentgenogram showing calcified caseous mass in lower pole of right kidney.

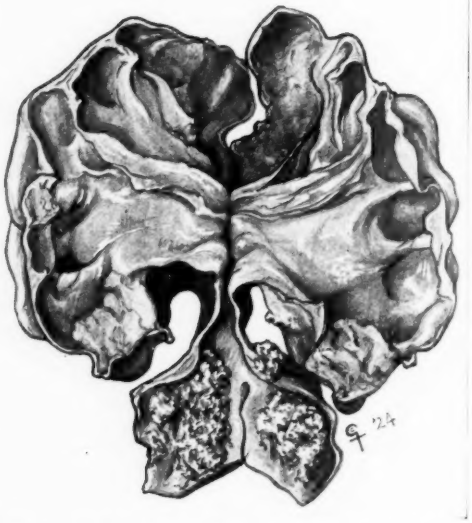

Fig. 2. Right kidney and upper 4 centimeters of ureter split showing hydronephrosis and large papillomatous mass in upper ureter (Case 1).

part of the urinary tract, implantation metastasis is likely to occur in any portion of that tract distal to the primary seat. Conversely, if there occurs a metastasis above the seat of the primary growth, it usually comes about through the lymphatic channels. The favored spots are the points of anatomical narrowing in the ureter, or in the bladder near the ureteral orifice. The urethra is not immune. The literature shows that even the histologically benign types have almost invariably developed local malignancy and metastases following operation, unless the surgery has been most thorough and comprehensive. Rarely they are very slow growing, perhaps existing more than 10 years.

CASE REPORTS

Case 1. Mrs. N. T., age 54, patient of one of us (Fairchild), was referred for urological examination, diagnosis, and advice as to treatment, December 26, 1923. She had one child; pregnancy, parturition, and puerperium were entirely normal. Ten years ago, while living in New York City, intermittent metrorrhagia was treated through the vagina (possibly by radium, as the authors could not get a clear description of the method), after which the bleeding disappeared with complete and permanent cessation of menstruation. She has never passed any gravel or stones, and never had dysuria or anything clinically indicating bladder or kidney disturbance until 6 months ago. In July, 1923, for first time she had hæmaturia which lasted 2 days, and was urged at that time to have a kidney study, but declined. At a mountain resort the hæmaturia disappeared. Hæmaturia and pain on the right side recurred coincidentally in September, 1923, and a mass gradually developed which could be felt in front below the ribs. Pain and mild hæmaturia persisted until operation. She had severe headaches, localized in the vertex, and attacks of dizziness. Personal and family history were otherwise irrelevant.

Examination. In the upper right quadrant of the abdomen there was a large, elongated, somewhat flattened mass, the size of 2 fists, extending up under the ribs. It was somewhat movable and quite tender on palpation, both front and back. Bimanually, it was extremely tender and felt definitely like a kidney. The inner lower edge was very distinct, and there was no tenderness on pressure over the lower right ureter or hypogastrium. The urine was tinged with blood; and there were few pus cells and few Gram-negative bacilli. Cystoscopy revealed no evidence whatever of papilloma or other growth in the bladder. A No. 7 catheter passed easily to the kidney pelvis on the left side. The right ureteral meatus could not be positively identified immediately. Slightly bloody fluid, however, oozed

Fig. 3. Pyelogram showing filling defect in papilloma of the kidney pelvis before late secondary changes have occurred (Case 2).

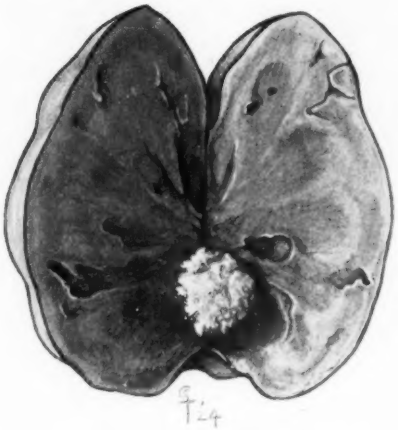

Fig. 4. Split kidney with papilloma in the lower part of the pelvis (Case 2).

feebly from this side at prolonged intervals. The bladder was otherwise normal. The right ureter could not be catheterized for more than 4 millimeters even with a whale-bone bougie. The X-ray had previously disclosed an irregular shadow 3 by 2½ by 2 centimeters in the region of the right kidney (Fig. 1). The patient was given 2 ampoules of indigocarmin intravenously; blue color appeared promptly from the catheter in the left ureter and there was an output of 9 per cent in 15 minutes, equivalent perhaps to 20 or 25 per cent of phenolsulphonephthalein. No dye could be distinguished coming from the right ureter. Blood urea nitrogen was 18 milligrams per 100 milliliters. Wassermann was negative. Inasmuch as she had a large painful mass on the right side, associated with a shadow resembling a stone, and considering the fact that there was no kidney function on that side, as expressed by dye output at the moment, nephrectomy was advised. The kidney was not only useless but was seriously and rapidly affecting her health and comfort, and the exact diagnosis could very well be made at the time of operation.

January 5, 1924. Admitted to Methodist Hospital (No. 25309).

January 7, 1924. Usual incision for nephrectomy (Fairchild). The mass in the right side, which consisted of a large hydronephrotic sac containing a small calculus and a partially calcified caseous mass in the lower pole, was removed with about 5 centimeters of ureter. (Notwithstanding the caseation, the kidney was distinctly not tuberculous.)

February 1, 1924. Left hospital after an uneventful convalescence.

Pathologist's report. A piece of ureter, about 4 centimeters in length, still attached to the kidney is greatly dilated, measuring 2.3 centimeters in diameter and is filled with a soft papillomatous growth which arises from the ureteral wall in many places (Fig. 2). The kidney itself is reduced to a thin walled shell enclosing the enormously dilated pelvis which is divided into several loculi. Small pieces of the same soft friable papillary material are found in the pelvis but are not attached. In the lower pole is an encapsulated, cheesy, partially calcified mass measuring 3½ by 5½ by 4 centimeters.

Microscopic examination is made of the thin papillary wall and ureter wall. There are small connective tissue strands covered by many-layered epithelium. The epithelial cells are somewhat irregular in size and a few mitotic figures are present. No invasion of the wall is found. The architecture is that of a papilloma but the epithelial changes are those of malignancy.

Diagnosis. Malignant papilloma of the ureter with hydronephrosis. The pain and hæmaturia were promptly and completely relieved, and the patient's health has so markedly improved that up to now she has not consented to another operation for removal of the entire ureter. The mild degree of hæmaturia associated with such a mass of friable papilloma, might be explained by early back pressure caused by intramural stenosis and consequent early destruction of kidney substance, resulting in nearly complete anuria from that side.

CASE 2. J. J. T., age 60, weight 160 pounds, consulted one of us (Day) July 26, 1923. At Chicago

in 1913 the patient was taken with a severe colic-like pain in the right lumbar region for which it was necessary during the next few hours to administer 3 hypodermics. He was transferred to a hospital there and the next day was told he had appendicitis. He consented to an appendectomy, but his pain suddenly ceased 2 hours later and the next morning he refused operation. He was perfectly well until 1918 when he had a similar attack, not so severe, but lasting 3 days. In 1921 he again had a mild attack of the same character which required no opiates and disappeared in a few hours after application of hot fomentations. In none of these attacks did he notice any blood in his urine nor was he aware of passing a calculus. In June, 1922, he was given a thorough examination by an internist, including gastro-intestinal study, but the results of this examination were negative. In November, 1922, and December, 1922, he had attacks of colic with a little blood and pain, requiring hypodermics. On January 1, 1923, after a strenuous New Year's Eve celebration, he had a severe attack of hæmaturia with renal colic and was sent to a hospital. He voided many clots at this time and at infrequent intervals thereafter, up to the date of his first cystoscopy, July 29. During the past 7 months he has had hæmaturia quite constantly and the only severe pain has been when hæmaturia ceased. He had many examinations during this period, but was never cystoscoped. July 28, 1923, he was admitted to Clara Barton Hospital (number 37290).

Examination. Blood: leucocytes 13,211, polymorphonuclears 85 per cent, and hæmoglobin 80 per cent. Urine: frankly bloody; occasional leucocyte; no residual. Rectal palpation revealed no evidence of carcinoma. Cystoscopy disclosed urethra, bladder, and bladder neck normal with no sign of prostatic hypertrophy or carcinoma and no vesical papilloma. Phenolsulphonephthalein appeared from the left side in 5 minutes. There was an output of 28 per cent in the next 15 minutes. Only bloody fluid appeared from the right side which, with the washings, after being diluted, boiled, and filtered contained no phenolsulphonephthalein; there was no bladder leakage of phenolsulphonephthalein. Blood urea nitrogen was 13 milligrams per 100 milliliters. The Wassermann was negative. Palpation of abdomen and loins was negative. Pyelogram on the right side (Fig. 3) showed a pear-shaped, fairly regular, partially obliterated outline of the pelvis which was somewhat enlarged and elongated, with dimness in the center and a denser shadow at the periphery.

August 4, 1923, right nephrectomy was done. A small normal appearing kidney was removed with 4 centimeters of ureter. The ureter appeared normal as it did in the pyelogram. The kidney was not split and inspected until *after* closure.

Pathological report is as follows: Specimen 10 by 6 by 4.4 centimeters (Fig. 4), weighs 140 grams. Lower end of the pelvis shows several small necrotic areas, from which the center has disappeared, leaving ragged friable walls.

Microscopic examination shows a tumor from the pelvis of the kidney, consisting of a soft, reddish-gray growth, necrotic in some places, with an irregularly elliptical base 1.2 centimeters in length, very friable, apparently a papilloma. Sections reveal finger-like projections having a vascular core and being covered by several layers of epithelium of cuboidal type, the cells at the tips of the papillæ showing marked asymmetry and numerous mitotic figures. Section from cortex and outer medulla shows moderate increase of intertubular connective tissue, with some epithelial degeneration. The glomeruli are swollen and show occasional leucocytes. Specimen undoubtedly is a malignant papilloma of the kidney pelvis, with secondary chronic nephritis.

The patient is in good health 11 months after operation. From August 31 to September 8, 1923, he received a total of 800 milliampere minutes of high voltage X-ray (220,000), divided into 40 minute treatments, current 5 milliamperes, distance 50 centimeters, size of port 24 centimeters, screening ¾ millimeter of copper and 1 millimeter of aluminum—2 treatments each front and back.

A pre-operative diagnosis of malignant tumor of the kidney was made in Case 2, but its papillomatous character was not determined. Studying the pyelogram in retrospect, we admit that its papillomatous nature should have at least been strongly suspected, even if not definitely diagnosed. At the time it was surmised that blood clots in the kidney pelvis were a large factor in causing the filling defect (Fig. 3).

SYMPTOMS AND DISCUSSION

A. Papilloma of the ureter. Hæmaturia is very common and is usually the first clinical manifestation. It has been noted in about 70 per cent of the cases of all tumors of the ureter and more often in papilloma. Sometimes the so-called tumor cells or even fragments of villi may be found in the urine, especially after the trauma incident to ureteral catheterization, a point on which Albarran laid great stress. In 7 of the recorded cases of McCarthy (12), diagnosis was aided or confirmed by this finding. Sometimes there is an associated bladder papilloma, due to the engrafting of bits of tissue broken off from the primary tumor above and carried down with the urine. Bloody urine may be seen coming from one ureter if cystoscopy is done while the attack of hæmaturia is on. Sometimes tufts of papilloma may be seen protruding from the ureter opening.

Hydronephrosis occurs in about 70 per cent. In an analysis by Kretschmer (9) of his 34 collected cases, it was present, at least to some degree, in all but 9 and in these there was no notation. It was not present in Culver's (5) case, but here the papilloma was very tiny. There is, therefore, likely to be a palpable mass under the ribs, hydronephrotic but not neoplastic. The ureter is often obstructed by growths at various levels, which at times prevent introduction of the catheter beyond those points. McCarthy (12) mentioned obstruction in 8 cases. The catheter often produces frank bleeding from the affected side, even in the intervals between attacks of hæmaturia. If situated low down, the tumor can sometimes be felt through the rectum or vagina (1 and 8) as was noted in the case of Judd and Struthers (8) and a few others.

Pain is usually concomitant with obstruction and is usually persistent, dull and distressing, and, in a few of the cases, quite pronounced in the hip, thigh or sacral region—root pains. At times, however, it is of the renal colic type, due to some sudden, practically complete obstruction from clots, ptosis, or other reason. Pain is usually a later manifestation in papilloma than in solid growths. Pyelo-ureterograms apparently have been infrequently made and the only examples found by the authors in the literature are those of Quinby (16) and Kretschmer (9). There is apparently nothing characteristic in either of these except the tendency for the catheter to take a decided curve to the outer side just above the pelvic brim.

B. Papilloma of the renal pelvis. Tumor cells or bits of villi in the urine, unilateral hæmaturia, bladder papilloma, and tufts protruding from the ureter, are quite as common as in the ureter cases.

These soft villous growths in the pelvis bleed very readily; hence hæmaturia is usually very early and rather profuse. Remissions may occur either from the cessation of bleeding or from obstruction. This obstruction may be at the pelvo-ureteral junction or in the ureter. It is attended with colic and, when the pressure becomes sufficient, may be followed by large amounts of bloody urine containing clots or bits of necrotic growth, with disappearance, or marked diminution in size, of the mass in the flank (a phenomenon known clinically as intermittent hæmatonephrosis). In the early part of the century, before the days of pyelography and kidney functional tests, Albarran and Israel were able to diagnose pelvic papilloma on two findings, viz: (1) unilateral hæmaturia and (2) intermittent hæmatonephrosis. The pain is usually of the intermittent colic-like type, punctuated by intervals of a more or less constant dull ache, or even entire freedom from pain. The obvious reason for this type of pain, as well as the hæmatonephrosis, is that, as the pelvis becomes distended and enlarged by the growth, or the bleeding is profuse, the blood will clot before it can be expelled; again the papilloma itself, or a broken-off necrotic fragment, may act as a ball valve or get caught in the ureter.

Fenwick's sign is suggestive but not pathognomonic of tumors of the pelvis. One of us (Day) has recently observed it in a patient, and it was the only cystoscopic or other objective finding, except the voiding of a few clots the day previous, that led to ureteral catheterization and pyelography and a diagnosis of solid renal tumor, verified at operation. Fenwick himself suggested that it was the result of trauma to the meatus and intramural portion of the ureter from the forcing out of blood clots. These clots sometimes resemble angleworms in form and size and may be of great length. Morris (14) observed a specimen 29 inches long. A comparative functional test always shows a marked lowering or absence of function on the affected side, as expressed by the output of phenolsulphonephthalein or indigocarmin.

Pyelography is most important. There has been a noticeable absence in the textbooks and most of the periodicals of pyelographic illustrations accompanying case reports. Herbst (13), Ockerblad(15), Gilbert Thomas (20), Colston (4), and Landon and Alter (10) published pyelographic reproductions in their case reports on pelvic papilloma. In many instances no mention was made of it; some had difficulty in catheterizing the ureter or getting by an obstruction. Others found

marked filling defects due to secondary changes (dilatation, etc.), not characteristic of the filling defect due to the papilloma itself. In still other patients the malignancy was so far advanced that pyelographic evidence of the primary site or pathological type was covered up; hence the amazing dearth of illustrations. Ockerblad's (15) patient was nephrectomized perhaps at the earliest stage of any on record—almost a microscopic tumor. (Reading the pathologist's report, both microscopic and macroscopic, one rather feels that this was a case of carcinoma but not papilloma as he termed it.) The pyelogram was practically normal as stated by Ockerblad and observed in the publication. In the pictures by Thomas (20), Landon and Alter (10), and Colston (4), the primary growths in the pelvis are overshadowed by secondary changes. Herbst's (13) and especially the authors' (Fig. 3) are apparently characteristic of pyelograms made after the papillomata had attained definite proportions but before dilatation and other secondary changes had taken place, and they are therefore of especial interest. Braasch in discussing McCown's (11) paper says, "When there is no tumor of the bladder, the diagnosis becomes more difficult. In the first place, if the growth is large enough, it may occlude the pelvis entirely. Usually, however, there is an irregular, partially obliterated, outline of the pelvis, together with much dilatation or elongation of one or more calyces. It must be remembered that partially organized blood clots in the renal pelvis may cause an outline simulating filling defects."

In other words, pyelo-ureterograms must be studied in conjunction with all the other clinical, cystoscopic, and laboratory data in order to make correct inferences and arrive at a reasonable pathological working diagnosis.

DIFFERENTIAL DIAGNOSIS

An early diagnosis necessitates that the practitioner, in every case of hæmaturia, no matter how innocent it may appear, resort to adequate urological procedures to determine, if possible, the precise source of the bleeding and the pathology behind it. The patient should be cystoscoped at once and not treated expectantly until the hæmaturia ceases; for in such case it may be difficult to determine the source of the blood until the hæmaturia recurs, which may not be for a long time in early cases. The only exception to this rule is when the terminal hæmaturia frequently accompanies an obviously acute gonorrhœal prostatitis, or when grave disease elsewhere contra-indicates any minor procedure.

If on cystoscopic examination, papilloma of the bladder is observed, we must always bear in mind the possibility of these being secondary to the same type higher up. Papilloma of the bladder is, however, a relatively common disease and clinical experience has shown that it is usually primary there. If a tuft of papilloma is protruding from the ureteral orifice, or there is observed a unilateral hæmaturia, or if there is other clinical evidence of unilateral kidney involvement, then the bladder growth is probably a transplantation metastasis from the kidney pelvis or ureter. Ureteral catheterization of the supposed healthy side should not be done at this time for fear of transplants being carried up from the bladder. Chromocystoscopy with indigocarmin will give a sufficiently reliable functional test.

In both these conditions *two* of the *three cardinal symptoms* of all renal neoplasms, namely, *hæmaturia* and *pain*, are fairly constant. The third, palpable tumor, is rather early in ureteral growths and a later manifestation in pelvic growths; it is still later in solid growths of the kidney. In ureteral cases the cause of the swelling is hydronephrosis; in pelvic cases hydronephrosis plus hæmatonephrosis. In the much more frequently encountered parenchymal tumor we palpate the growth itself, for here dilatation of the pelvis is extremely rare unless there was a previous hydronephrosis, a small stone or other obstruction, or necrosis has taken place. Hæmaturia is usually more profuse in pelvic papilloma than in tumors of the ureter or renal parenchyma. In the ureter it usually occurs early but is generally mild in character, while in solid tumors of the kidney the bleeding is more likely to be a late development, often with long periods of remission.

In the so-called essential or symptomless hæmaturia, bleeding is more or less constant, usually with no clots, and urological examination reveals a normal function and a normal pyelogram.

The absence of frank pus in the urine, especially in the early cases, has been pointed out by many writers. This, plus cystoscopy and examination for tubercle bacilli, is a distinct aid in ruling out renal tuberculosis.

Stone is an occasional coincidental finding in either of these diseases and is likely to be misleading.

If ureteral catheterization, comparative functional tests, and pyelography, in a patient with unilateral hæmaturia, fail to demonstrate evidences of a pathological condition, they should be repeated at reasonable intervals if the hæmaturia persists.

Correct clinical diagnosis has been the exception in tumors of the ureter and in the pelvic papilloma the percentage has been strikingly small. We must, therefore, be satisfied in perhaps the majority of cases with a working diagnosis. Adequate and comprehensive urological study (modified necessarily by the exigencies of the case), based on microscopic urinalysis, cystoscopy, comparative kidney function, ureteropyelography, rectal, vaginal, and abdominal palpation, plus clinical data, will afford us a picture which tells us at least when to operate, but a final diagnosis must often be made at the operating table. The prognosis will depend on how early and how rigid has been our examination and how attentive and systematic our investigation at operation.

TREATMENT

To brand these cases as instances of malignancy is the first principle in their therapy. Nothing short of complete nephro-ureterectomy should be considered.

Resection of the ureter, for a tumor low down, and re-implantation into the bladder or gut has gone into the discard since the routine use of pyelography and modern kidney functional tests, and its employment is justified in the most exceptional case only, since the hydronephrotic kidney is badly crippled at best.

McCarthy (12), in discussing tumors of the ureter, says, "the first encounter with a case of this type will bring disaster to both physician and patient if the physician fails to profit by the experienec of previous observers." This statement is nearly as true of tumors of the kidney pelvis. There has been a sufficient number of cases reported in detail to permit some conclusions. While all writers are agreed that a primary ureteronephrectomy is the ideal operation, yet in ureteral cases it has been done but six times by six different operators, and in about the same number for pelvic papillomata. There have been valid reasons for this. First, cases have been few and the pioneers had to learn through hectic experience; second, so many times, at nephrectomy for tumor, the kidney is not split and carefully examined until closure is made, as happened in Case 2. Third, the patient's condition is often deemed not fit for the additional surgery at the moment. When nephrectomy is done for tumor of the kidney, or if for any other reason there is marked unilateral hæmaturia, closure should not be made until the kidney is split, examined, and found free from papillomatous growth, by the surgeon, assistant, or pathologist. If no gross pathology whatever is found in the kidney, even then ureterectomy is advisable. Culver (5) had to remove a ureter, which contained three small papillomata, several weeks after a nephrectomy done elsewhere; the kidney removed showed nothing to account for the hæmaturia. A ureterogram made just prior to the ureterectomy was negative because the growths were so tiny. According to Scholl (17), Derewenko opened the kidney and explored it digitally but found no growth; however, 7 months later nephrectomy was necessary because of severe bleeding. Four papillomata were found in the renal calyces. Obviously, palpation was not sufficient as it would not have been in the authors' case (Case 2).

Ureterectomy is quickly and easily performed through a comparatively small additional incision and with little or no added risk, if done at the same time as nephrectomy, unless the patient's condition is bad. An exception to this is an infiltrating tumor, meso-

thelioma, sarcoma, carcinoma, or other solid tumor of the ureter, such as that in Quinby's (16) case. It is only in the late stages of papilloma that the outer coats of the ureter or the peri-ureteral tissues are involved. If the operation is difficult by reason of a large tumor, infiltration, and adhesions, the operation will probably be useless. On the other hand, secondary ureterectomy is likely to be a rather difficult operation which requires a long incision and entails much difficulty in dissecting out the upper ureter from the scar—particularly so if radium or deep X-ray has been used. The method of Beer (3) should be used if a pre-operative diagnosis of papilloma has been made; or the ureter may be severed with the cautery between ligatures and ureterectomy performed if, after splitting the kidney, papilloma is discovered. It may be, and often is, necessary or advisable to remove a section of the bladder surrounding the ureteral meatus. All growths and recurrences in the bladder should be dealt with appropriately by d'Arsonval current through the cystoscope, or by suprapubic exposure after the high frequency methods of Corbus or MacGowan, or by the Percy cautery. Excision, radium and deep X-ray have, for the most part, been failures. Better results, with less secondary fibrosis in the bladder, would probably have been obtained by the methods above mentioned.

CONCLUSIONS

1. When a patient has hæmaturia, or any other symptom likely to be of renal origin, his physician should not be content until he discovers: first, the primary source of the bleeding and, second, the pathological nature and extent of the lesion behind it, if it is reasonably possible by an adequate urological examination.

2. Thorough urological examination may not result in an absolutely accurate pathological diagnosis, but in a general way it does tell the surgeon what to do and notifies him to look for the unusual and unexpected, as well as the every-day pathological findings.

3. Primary nephro-ureterectomy offers the patient the maximum chance of complete cure, and a two-stage nephrectomy and ureterectomy should not be necessary in an increasingly larger percentage of cases if a few simple rules are observed.

4. In the removal of a neoplastic kidney or if there is suspicion of any kind of tumor, splitting and examination of the kidney should be made before closure.

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THE EFFECT OF GENERAL ANÆSTHETICS ON THE ORGANISM AS A WHOLE[1]

BY WILLIAM DE B. MACNIDER, M.D., CHAPEL HILL, NORTH CAROLINA
Kenan Research Professor of Pharmacology, University of North Carolina

IN studying the effect of general anæsthetics when used on laboratory animals and also when these substances are employed for clinical purposes, there is a tendency to concentrate our observations on certain definite systems or organs of the body, and not to consider those changes of a more general and fundamental character which the anæsthetics may induce in the organism as a whole. Both in the laboratory and operating room we study with a variable amount of care and interest the effect of these substances on the cardiovascular, respiratory, and renal systems and frequently ignore those changes which the anæsthetics may induce in the physicochemical state of the organism by producing changes in osmotic pressure, body temperature, and in the acid-base balance of the blood.

The following study of the effect of ether on the acid-base equilibrium of the blood in normal animals of different age periods is a continuation of work previously undertaken in this laboratory (1, 2, 3, and 4).

THE STABILITY OF THE ACID-BASE EQUILIBRIUM OF THE BLOOD IN ANIMALS OF DIFFERENT AGE PERIODS WHEN ANÆSTHETIZED BY ETHER

Twenty-six normal dogs have been employed in this series of experiments. The age of the animals has varied from 4 months to 11 years and 7 months. The animals were kept in metabolism cages, fed on bread and scrap meat and given 250 to 400 cubic centimeters of water by stomach tube twice a day. The cage or catheterized specimens of urine were examined qualitatively each day for albumin, glucose, and diacetic acid. Centrifugalized specimens were examined for tube casts. The phenolsulphonephthalein test for kidney function was determined by the method of Rowntree and Geraghty (5). The reserve alkali of the blood (acid-base balance) was determined by the method of Marriott (6).

In these animals of different age periods, with one exception, the urine was normal. The phenolsulphonephthalein kidney test was normal and showed an output of the dye in 2 hour periods for the respective animals that varied from a minimum of 77 per cent. The reserve alkali determinations of the blood varied within the normal readings of 8.05 to 8.15. One of the animals of the series, 7 years and 8 months old, showed on several occasions a trace of albumin in the urine. There were no casts. The elimination of the phthalein was 63 per cent. The reserve alkali of the blood was 8.1.

From these observations the conclusion appears clear that in normal animals of such wide variation in age, the acid-base balance of the blood is maintained at the normal and one of the fundamental states of the blood which constitutes one element of its physicochemical evironment is kept at the normal point to aid in the proper functioning of the various organs and systems of the body.

The 26 animals of the series were anæsthetized by ether for a period of 2 hours. A cannula was placed in each ureter in order to obtain a record of urine formation. The reserve alkali of the blood was determined at the commencement and termination of the experiments. One cubic centimeter of a solution of phenolsulphonephthalein was injected into the muscles of the thigh, and the output of the dye determined at the end of a 2 hour period. The results obtained from the use of ether in these animals of different age periods have been as follows:

The young animals and adult animals up to between 2 and 3 years of age have failed to show during the period of anæsthesia any marked reduction in urine formation. The flow of urine in the different animals has varied from 6 to 13 drops per minute. This

[1]Read before the Southern Association of Anæsthetics, Washington, D. C., November 13, 1923.

urine has not contained albumin or casts. The elimination of phenolsulphonephthalein during the period of anæsthesia has shown only a slight reduction from the normal elimination of the dye prior to the anæsthesia. The animal of Experiment 7 had a normal elimination of the dye before the anæsthetic of 73 per cent. During the anæsthesia it was reduced to 60 per cent. The reserve alkali of the blood in these young and adult normal animals has remained unchanged during the period of anæsthesia and has varied from 8.05 to 8.15.

A study of the changes developing in the old normal animals, dogs varying in age from 4 years to 11 years and 7 months have been in striking contrast to the results outlined for the younger animals. In all these animals after 1 hour of surgical anæsthesia, there has occurred a marked reduction in urine formation or an anuria has been established. The animal of Experiment 16, 7 years old had at the commencement of the experiment a flow of urine of 13 drops per minute. At the end of the first hour of the anæsthesia the flow of urine was reduced to 4 drops per minute. The urine contained both albumin and casts.

The animal of Experiment 21, 6 years and 4 months old, had a flow of urine of 11 drops per minute. At the end of the first hour of the anæsthesia the animal had become anuric and remained anuric throughout the remaining hour of the experiment.

In the older group of animals there has not only occurred a marked reduction in urine formation with the appearance of albumin and casts in the urine and more rarely diacetic acid, but the elimination of phenolsulphonephthalein has undergone a sharp reduction in output. The animal of Experiment 16, had a normal elimination of the dye of 71 per cent. During the 2 hour period of the anæsthesia the total output was 21 per cent. The animal of Experiment 21, had a normal output of 68 per cent. During the anæsthesia the elimination was reduced to less than 6 per cent.

In these old normal animals the earliest evidence of injury from the anæsthetic has consisted in a disturbance in the acid-base balance of the blood. As early as 15 minutes following the establishment of a state of surgical anæsthesia and before urine formation is reduced there may occur a decrease in the reserve alkali of the blood. By the end of the first hour of the anæsthesia there has developed in all of the older group of animals a marked disturbance in this physicochemical state of the blood. The animal of Experiment 16 had a normal alkali reserve reading of 8.1. At the end of the first half hour of the anæsthesia the reading was 7.95; at the termination of the experiment 7.8. The animal of Experiment 21 had a normal reading of 8.1. At the end of the first half hour of the experiment this was reduced to 7.8, and at the end of the experiment was 7.65. There has been a definite relationship between the time and degree of reduction in the reserve alkali of the blood with the amount of urine formed and the ability of the kidney to eliminate phenolsulphonephthalein.

The point of definite interest and significance in this series of experiments is as follows:

Puppies and young adult animals of the series were anæsthetized with ether for a 2 hour period without developing any disturbance in the acid-base balance of the blood. In animals of such age periods this physicochemical state of the blood appears stable and difficult to influence by an anæsthetic. Such animals during the anæsthesia continue to form a urine practically normal in amount and normal in composition. The elimination of phenolsulphonephthalein is but slightly reduced.

Adult dogs 4 years old and the old animals of the series when anæsthetized by ether for a similar period of 2 hours, show that the old organism has an acid-base balance of the blood which is not stable and which can be easily reduced by the use of such an anæsthetic substance. When such a reduction has been effected in the reserve alkali of the blood of such animals, there develops a reduction in urine formation or the establishment of an anuria. The urine contains albumin and casts and more rarely diacetic acid. The elimination of phenolsulphonephthalein is greatly reduced or present in the urine as an indeterminate trace.

The experiments show that ether is more toxic for an old organism than for a young or-

ganism. This toxicity is first expressed by the anæsthetic substance inducing such a change in the physicochemical state of the blood that one organ at least, the kidney, is furnished a blood of such altered composition that it fails to functionate in a normal fashion.

It would appear that, prior to the use of an anæsthetic in an aged patient, the organism should be protected against the anæsthetic by the use of a diet rich in carbohydrates and by the judicious use of sodium bicarbonate in order to maintain during the anæsthesia a normal acid-base equilibrium of the blood.

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THE LEFT SIDED ABDOMINAL ABSCESS AS A COMPLICATION OF APPENDICITIS

By CARL NATHER, M.D., and ALTON OCHSNER, A.B., M.D., Chicago
From the Surgical Clinic of the University of Zurich, Zurich, Switzerland, Professor Clairmont, Director

In studying the usual abscess formations in cases following appendicitis, one is struck with their manifold manifestations. Aside from the subphrenic abscesses which are located above the transverse colon, one finds the following abscess types within the abdominal cavity.

1. The ilio-inguinal type located above the right inguinal ligament and extending up to and often above the anterior iliac spine, i.e. lateral to cæcum and ascending colon in the iliocæcal fossa and separated from the abdominal cavity medially by the omentum and small intestine. This is the most common of all abscess types and results from a laterally located appendix (Vogel, Senechal).

2. Abscesses similar to the first type but located medial to the cæcum and in close relation to the bladder and the anterior abdominal wall.

3. Abscesses, as in type two, located medial to the cæcum but with no relation to the anterior abdominal wall. The walls of the abscess are made up of adherent loops of intestine and omentum. Both forms of type two and three follow cases in which the appendix is medially located.

4. The posteroparietal type located, as the name signifies, posteriorly and above in the lumbar region with no relation to the iliac fossa. The appendix in these cases is usually located posteriorly and above the cæcum.

5. The pelvic type occurs in those cases in which the appendix is located low and medially and often reaching into the true pelvis. The resulting abscess is found in the cul-de-sac of Douglas.

6. The rarest of all abscess types in cases following appendicitis is the left-sided abscess which is found especially in children. Sprengel, Wolff, Brunn, Giertz, Vogel, and Fromme have observed this condition but comment upon its rarity. In the course of 4 years among 700 cases of acute appendicitis treated in the surgical clinic of the University of Zurich, 9 cases of left-sided abdominal abscess were observed.

Because of the similarity between many of the cases, we have chosen the few following ones as examples of this condition.

Case 1. K. E., age 12 years. Archive number 1830–1920. Operation for acute appendicitis and general peritonitis. The appendix was located medially and below and was partially necrotic. An appendectomy was done and the abdominal wound closed without drainage. Patient was placed in Fowler's position. Two days after operation an abdominal wall abscess was opened. On the fourth postoperative day the abdomen was distended and

there was tenderness in the left lower quadrant. After 2 days a painful resistance was palpable in this region. Rectal examination was negative. After application of heat, resistance became smaller and after 14 days completely disappeared although tenderness remained. Patient was discharged from hospital 43 days after operation, cured.

CASE 2. P. Sch., age 18 years. Archive number 1063–1920. Patient had abdominal pain for 10 days. Eight days before admission patient had sharp pain in right lower quadrant of abdomen, with vomiting. Above the left ilium and left Poupart's ligament was a definite swelling with muscle resistance. After 5 days' rest in bed, in Fowler's position, and heat to the left lower quadrant the swelling became larger. Operation was done 6 days after admission. A left pararectal incision was made. After opening the peritoneal cavity, the abscess cavity was drained by separating the adherent loops of intestine. There was no extension of abscess into pelvis. Five weeks later patient discharged cured.

CASE 3. H. O., age 12 years. Archive number 2125–1921. Operation for acute appendicitis. The abdomen was filled with cloudy exudate. The appendix was located medially and below. Upon removal of the appendix a small abscess in its vicinity was opened. Appendectomy was done and after sponging out the abdominal cavity the abdominal wall was closed without drainage. On the fifth postoperative day patient had fever. Rectal examination revealed a swelling of the anterior wall of the rectum in the region of the cul-de-sac of Douglas, with fluctuation. The abscess was drained through the rectum. About 200 cubic centimeters of pus were evacuated. Four days later temperature was normal and infiltration in the rectum almost completely disappeared. On the following day, however, temperature again increased and patient had pain in the left lower quadrant. Lateral from umbilicus was a point of tenderness and a swelling. Over the swelling existed an œdema of the skin. Operation. A left pararectal incision was made over the swelling. The peritoneum was thickened and adherent to the intestinal loops. After separation of these adherent loops an abscess cavity was opened. Four days later the temperature again became normal and the patient was symptomless. Patient was discharged 35 days after admission, completely cured.

CASE 4. A. A., age 17 years. Archive number 1837–1923. Abdominal pain for 8 days. Ten hours before admission to the hospital patient had increase in all symptoms, with vomiting and fever. At operation, a small retrocæcal abscess was opened and the perforated appendix was found. Appendectomy. The abscess cavity was sponged out with rivanol. The abdominal wall was closed without drainage. An abdominal wall abscess was opened 3 days later, after which the temperature dropped to normal. On eighth postoperative day patient got out of bed and on twenty-second postoperative day was discharged, symptomless. Twenty-six days after the appendectomy patient had an attack of pain in the left side of the abdomen. After 3 days of rest in bed, the pain became localized in the left lower quadrant. Readmitted into the clinic. In the left lower quadrant close to the ilium a well defined, very painful tumor about the size of an orange was found. In order to facilitate the possible gravitation of the abscess into the pelvis, patient was treated with hot applications to abdomen and placed in Fowler's position. Because of the increasing pain and the lack of any swelling felt in the rectum, it was decided to operate. Incision was made over the tumor parallel to Poupart's ligament. The peritoneum was thickened and œdematous. After separating the adherent loops of intestine, an abscess containing about 50 cubic centimeters of pus was opened. Seventeen days later patient was discharged cured.

The above four cases represent the various types of left sided abscess which we observed in the Zurich Surgical Clinic.

There is considerable difference of opinion as to the cause of the formation of an abscess on the left side of the abdominal cavity in cases following appendicitis in which the primary purulent process is located on the right side. Sprengel is of the opinion that the left sided abscess, as well as the other abscesses not directly communicating with the appendix, is a result of pus within the abdominal cavity which may later become localized and form an abscess. This would hold true for all cases of general peritonitis.

The theory advanced by Moszkowicz does not necessitate the presence of pus within the abdominal cavity but merely the presence of an inflammatory exudate which later becomes infected from the original focus thus resulting in an abscess formation. Moszkowicz also believes that there are certain sites of predilection for the collection of these inflammatory exudates.

Schlange believes that multiple abscesses within the abdominal cavity were originally communicating with the primary abscess and and only later became separated from it by adhesions. Two of our cases, as illustrated by Case 3, may be considered examples of this type as first an abscess developed in the cul-de-sac of Douglas and later one in the left abdomen. In both these cases a small abscess in the region of the appendix also was opened at the appendectomy.

A further possibility for the formation of the left sided abscess is in those cases in

which the appendix is located medially in the region of the bladder. The purulent exudate passes from the right side to the left over the superior surface of the bladder. This theory has been advanced by Rotter and Sprengel. Sprengel also believes that in those cases in which the appendix is located within the true pelvis, there may first result a pelvic abscess with direct extension into the left side of the abdomen after the pelvis becomes filled.

A last possibility exists in those cases of situs inversus viscerum which are, however, very seldom.

According to their location abscesses on the left side of the abdomen are divided into two different forms: *First* the usual form which has the same location as an abscess on the contralateral side of the body in the right ilio-inguinal region. It is bounded below and laterally by Poupart's ligament and above and medially by adherent loops of intestine (Case 4). This lower form of abscess formation is not to be confused with an abscess within the pelvis. An intermediary form is, however, possible. A left sided abscess may extend into the true pelvis or a pelvic abscess above into the abdominal cavity. In those cases where a swelling is palpable in the rectum and a tumor also in the left lower quadrant, one can only determine with certainty the presence of one or two abscesses by draining one. *Second*, the unusual form which is located at a higher level usually in a line connecting the two anterior iliac spines (Case 3). This form, because of its position, is easily differentiated from abscesses in the cul-de-sac of Douglas.

Anatomically the left sided abdominal abscess is characterized by its tendency to approach the anterior abdominal wall as demonstrated by Sprengel. This explains in all probability the reason why these abscesses peculiarly do not gravitate into the pelvis even when treated expectantly. Even when treatment with Fowler's position is immediately instituted after the appendectomy, it is sometimes impossible to prevent the formation of this complication.

The explanation of the wandering of the left sided abscess toward the anterior abdominal wall can naturally not be the same as Sprengel had given for those abscesses located on the right side. He explained the presence of right sided abscesses in the region of the parietal peritoneum as being caused by the position of the appendix. Meisel is of the opinion, however, that the tendency for these abscesses to localize parietally is due to the fact that the visceral peritoneum is much more capable of absorption.

One must consider another very important possibility. With the existence of an abscess between the loops of intestine there probably results through local irritation a temporary paralysis of the intestine in the immediate neighborhood. As a result of this localized intestinal paralysis the affected loops of intestine become distended with gas with the natural tendency to extend toward the anterior abdominal wall carrying with them the abscess contained between the adherent loops. Those abscesses which form originally posteriorly between the mesentery, omentum, and intestinal loops have a tendency also to extend toward the anterior wall, because with the increase of the fluid contents of the cavity there is no possibility for it to extend posteriorly against the fixed posterior abdominal wall leaving the only one possibility anteriorly.

As previously mentioned children seem to be especially affected by this complication. In our 9 cases 4 were less than 13 years of age. Because of this frequency of its occurrence, one should always suspect its formation in all cases of appendicitis with an unusual course in children.

The symptoms of the left sided abdominal abscess are usually pain in left abdomen with at first no definite physical signs. Soon, however, there is an increase in temperature with also an increase of the leucocytes in the blood. If the process continues further there results a point of tenderness in the left lower quadrant and later the formation of a painful tumor. With these symptoms and signs in cases following acute appendicitis the making of a diagnosis is easy.

Treatment consists primarily in rest in bed and warm applications to the abdomen. As our Case 1 and several other cases in our series have shown, all symptoms and signs can disappear under expectant treatment.

Also, because of the tendency of the abscess to approach the anterior abdominal wall it is advisable to observe the case and allow the abscess a chance to advance as far anteriorly as possible. As soon as one is sure, however, that the condition will not respond to conservative treatment surgical measures must be resorted to. Incision should be made over the point of resistance and as the abscess is very often covered with loops of intestine it is necessary to separate carefully the usually fresh adhesions before gaining access into the abscess cavity. As a rule, it is possible to drain the abscess without opening the free peritoneal cavity, but in those cases in which it is not possible the general peritoneal cavity must, under all circumstances, be well protected.

CONCLUSIONS

The left sided intra-abdominal abscess represents a typical complication of both the conservatively and the radically treated cases of appendicitis. It results either from direct communication with the diseased appendix or from primarily or secondarily infected exudate collections.

Two forms of left sided abdominal abscess are found, a superior and an inferior. The latter is to be differentiated from pelvic abscesses.

The clinical symptoms are similar to those characteristic of any other intra-abdominal abscess.

Children are especially subject to this complication following appendicitis.

Treatment is at first conservative which is sufficient for a certain percentage of cases.

If no good results are obtained by conservative methods of treatment, however, incision is indicated.

If the patient's condition permits, it is advisable to await the approach of the abscess to the anterior abdominal wall, which occurs in the majority of cases.

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PRIMARY CARCINOMA OF THE KIDNEY[1]

By JOHN L. DIES, M.D., Rochester, Minnesota
Fellow in Surgery, The Mayo Foundation

GARCEAU, in reviewing a series of renal tumors compiled from cases from the necropsy and operating rooms of the Massachusetts General and Boston City Hospitals during a period of 10 years (1899 to 1909), was able to find only 3 cases of carcinoma. Swan and Stevens both assert that probably not more than 2 per cent of renal tumors are carcinomata. Reiche, in 11,930 cases of cancer, found eighty renal neoplasms (0.7 per cent). Young found in the records of Johns Hopkins Hospital only one case of true adenocarcinoma of the kidney. Eisendrath believes that the majority of cases of carcinoma of the renal parenchyma occur in adults, only a few having been found in children. Albarran and Imbert, in 1913, found but 13 cases of malignant adenoma in 529 cases of renal tumors. Wilson reported 3 cases of primary carcinoma of the kidney observed at the Mayo Clinic in the 10½ years preceding 1916.

Garceau maintains that carcinoma of the pure type is extremely rare in the kidney, and insists that the tumor most commonly found is that derived from adrenal rests, namely, hypernephroma. Ransohoff believes that sarcoma of the kidney occurs more often than carcinoma in the first decade of life. Lilienthal agrees with him, saying that renal tumors of young children are more likely to be sarcomatous than carcinomatous. According to Eisendrath also, sarcoma is the most common type of tumor in children; it is usually of the round or spindle-cell type, grows very rapidly, and invades the veins comparatively early. Eusterman says: "Well authenticated cases of renal carcinoma, sarcoma, and malignant adenoma are comparatively few."

SYMPTOMS

According to Braasch, the cardinal symptoms of malignant growths of the kidney are hæmorrhagic urine, tumor, and pain. "Given a clinical picture of a palpable tumor in the region of the kidney, hæmorrhagic urine, and the general symptoms of malignancy, the diagnosis of malignant renal tumor will usually be found correct."

ORIGIN

Waldeyer has shown that carcinoma of the kidney originates in the preformed glandular anlage of the urinary tubules. White and Martin believe that it develops from the tubular epithelium, or occasionally, from the epithelium of the pelvis. According to Stengel and Fox, the growth begins as a soft, white

Fig. 1.

Fig. 2.

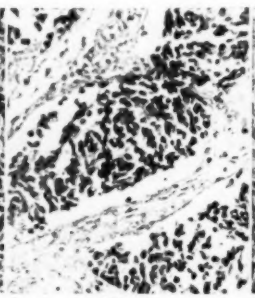

Fig. 3.

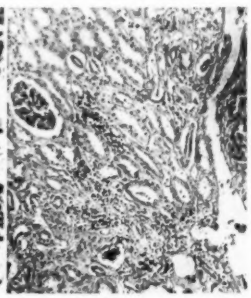

Fig. 4.

Fig. 1. Adenocarcinoma with differentiation into the glandular structure. Photomicrograph. (× 140).

Fig. 2. Adenocarcinoma with differentiated and undifferentiated areas. Photomicrograph. (× 140).

Fig. 3. Adenocarcinoma with undifferentiated area. Photomicrograph. (× 140).

Fig. 4. Adenocarcinoma with undifferentiated area and renal structure. Photomicrograph. (× 70).

[1]From the Department of Surgery, University of Tennessee, Memphis.

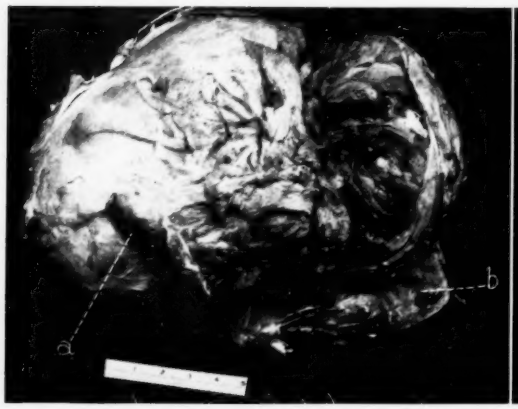

Fig. 5. *a*, Undeveloped ovary; *b*, remains of kidney.

Fig. 6. Gross specimen of tumor.

tumor in the cortical substance or in the medulla; in case of hæmorrhage into the tumor, it turns red. Magoun and MacCarty believe that the neoplasm of infancy may originate from the wolffian body, from the embryonic kidney, or from aberrant cells of the myotome or other similar structures.

ETIOLOGY

The cause of carcinoma of the kidney is still a matter of controversy. Calculi are frequently an associated complication. Stevens found them in 66 per cent of his cases. Coryell, in a review of 140 cases of renal stone at the Mayo Clinic, found 9 in which cancer was also present. The constant irritation by the stone seems to be the cause of the cancer. Virchow was the first to call attention to the causation of cancer by mechanical or chemical means. Ebstein mentions 6 cases of renal cancer caused by trauma. According to Bugbee, infection, as well as nephrolithiasis, is suggestive as a causative factor. Heredity also may play a part. Binnie mentions malformations (for example, horseshoe kidney) as having been found in cases of renal cancer. Males are more prone to be affected than females. Metastasis occurs by way of the veins or the lymphatics.

OPERATION

Nephrectomy is generally recognized as the only means that offers any hope of cure in cases of malignant disease of the kidney. The choice of the lumbar, the abdominal, or the transperitoneal route of removal usually depends on the case. Usually the posterior or lumbar route is followed for small and moderately small tumors. If tumors are too large to be removed thus, the transperitoneal method is the one generally followed.

REPORT OF CASE

A little girl, aged 4 years, was brought to the hospital because of a large swelling in the abdomen. She had hitherto been in fair health, although never quite as robust as the average child of her age. The bowel movements were regular and urination was normal. There had never been any hæmaturia, stones, pain on voiding, or dysuria. Three months before hospitalization, the mother had first noticed that the child's abdomen was becoming hard. This hardness increased steadily, and at the time of examination, there was a mass about 17.5 by 10 centimeters. Recently she had lost much weight.

The child was found to be undernourished and anæmic, with a pale face and eyes somewhat sunken in. There was a large, hard mass in the abdomen, which appeared to originate either from the ovary or the right kidney, probably the latter. The mass was not tender, but seemed quite firm and well encapsulated. The urine was rather dark in color, with a specific gravity of 1.010, a trace of albumin, no blood, and no casts, but a few pus cells. The hæmoglobin by the Sahli method was 65 per cent; the erythrocytes numbered 2,500,000, and the leucocytes 14,200. The differential count was 73 per cent for polymorphonuclear leucocytes, 21 per cent for mononuclear lymphocytes, and 2 per cent for large mononuclears. The X-ray showed a tumor in the right abdomen that excluded all viscera from that side.

The mother was informed of the findings, and also told that, because of the physical condition of the child and the extreme size of the tumor, operation would be extremely hazardous. Nevertheless she requested that operation be performed. Accordingly under gas ether anæsthesia, the growth was removed with great difficulty in 40 minutes; the transperitoneal method was used. The patient's condition before, as well as during the operation, was very poor, but it was hoped that, by rather fast and at the same time careful work, the tumor could be removed with impunity. The child, however, never rallied completely and died a few hours later without regaining consciousness.

The pathologist reported a large, oval tumor, weighing 3.5 pounds (1591 grams), which had attached to its outer surface what appeared to be a small, undeveloped tube and ovary. The tumor had a thin fibrous capsule, and it cut easily, showing a soft, almost gelatinous mass of tissue which in certain areas was grayish; in others, markedly vascular; and in still others, there were very small masses of renal tissue. Around some of these areas of renal tissue were small retention cysts containing a watery fluid. The diagnosis was adenocarcinoma of the kidney (Figs. 1 to 6).

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ACTINOMYCOSIS OF THE OVARY AND TUBE

By FERDINAND C. HELWIG, M.D., Kansas City, Kansas
From the Department of Pathology, University of Kansas Medical School

ACTINOMYCOSIS of the internal female genital tract is a chronic burrowing infection which occurs more frequently than is commonly supposed. It is due to the actinomyces, the organism which has the gastro-intestinal tract as its normal habitat and which produces the well-known specific, chronic inflammatory condition which is associated with abscess and sinus formation. It should not be confused with another organism which resembles it in many respects but is widely distributed in nature and is, according to most authorities, in no way responsible for the condition under discussion and should be classified, as advised by Wright, under the heading of nocardia.

There is considerable difference of opinion regarding the source of the actinomycotic infection, and there are two distinct theories in this respect. The first and most plausible theory is that of Wolff and Israel who claim that the organism causing actinomycosis is a normal inhabitant of the gastro-intestinal tract and usually gains entrance through some abrasion or in conjunction with a foreign body. The opposing theory, first formulated by Bostroem has become so thoroughly incorporated into the literature that it has been generally accepted. It is warmly supported by Mattson who maintains that there is but one organism namely: that advocated by Wolff and Israel and that " it is not a normal inhabitant of the gastro-intestinal tract and oral cavity, but has its origin outside the human body, is capable of dual existence primarily as a saprophyte in old sod soil from which it gains access to grains and grasses and through this medium becomes capable of infecting man and the lower animals." Mattson apparently disregards the fact that the organism which grows outside on the grains and grasses and in the old sod is an aerobe, very easily cultivated and cannot be transferred to animals by inoculation, while the organism of Wolff and Israel is anaerobic, grows only at body heat and is very difficult to cultivate.

Wright, whose excellent work in 1905 did much to support the hypothesis of Wolff and Israel, demonstrates rather conclusively that the organism found so commonly in nature, differs profoundly from the human and bovine type of actinomycosis, particularly in that it has spore-producing elements. Colebrook who obtained mycelial organisms from 24 cases of human actinomycosis found that 23 of these were anaerobes and that all of them conformed in their general characteristics to the anaerobic type described by Wolff and Israel. He was unable to transfer these to sterile oats and other grasses and then transfer them to animals by intrapleural and intraperitonal injections. Lord injected the material extracted from tonsillar crypts and carious teeth cavities into guinea pigs and produced morphologically typical actinomycotic lesions but did not isolate the organism. Davies recently has made a study of the crypt contents of human tonsils and he concludes, "In man the granules found in crypts are for the most part composed of radiate non-branching mycelial structures, fusiform bacilli, spirochætæ and cocci; and true actinomycosis does not occur." Cope thinks that the infection almost universally arises from the mouth and alimentary tract, and he cites 2 cases which are clinically very convincing. In his first case the patient had been in a fist fight and knocked out his adversary's tooth. As a result he had an abrasion on the knuckle and an actinomycotic lesion subsequently developed. The second case is that of an actinomycotic abscess in direct continuity with the cavity of a carious tooth. McWilliams reports a case of actinomycosis of the finger resulting from a fistic encounter and the loss of a tooth. Israel found a piece of tooth in the bronchus of a case of thoracic actinomycosis. Warwick cites two cases, one similar to Israel's; only in this instance the

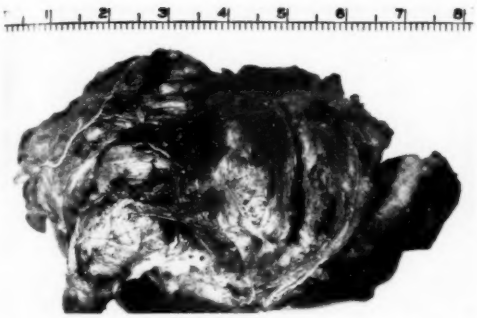

Fig. 1. External appearance of ovarian mass showing thick adhesions and irregular lobulation.

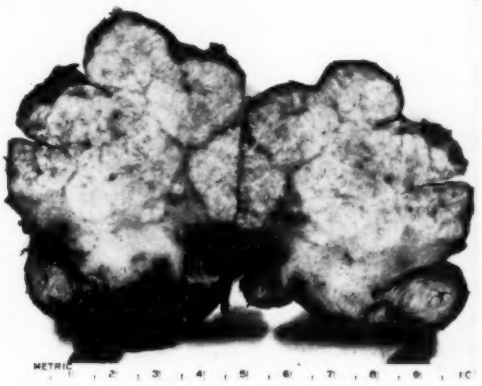

Fig. 2. Cross section of ovary presenting wormeaten appearance, dense interlacing fibrosis and loss of ovarian substance.

teeth were pulled while the patient was under general anæsthesia. Following this the patient developed thoracic actinomycosis and coughed up the tooth. His second case is that of a man who had one tooth pulled followed by actinomycosis of the jaw. Stengel tells of a case of actinomycosis of the jaw following a wound produced by a tooth extractor. New and Figi, in analysing 159 cases from the Mayo Clinic, seem to favor the view held by Wolff and Israel. They reported one patient who developed actinomycosis while being treated for pyorrhœa, and 6 cases who developed the disease after having teeth extracted. They likewise reported 1 case following the removal of the tonsils. The literature is replete with such instances, yet this theory has apparently received little consideration.

PATHOGENESIS

While performing a routine autopsy upon a body, Chiari discovered a round gray patch in the cæcal mucosa which measured about 1 centimeter in diameter and 5 millimeters thick and showed a ray fungus the filaments of which had penetrated and filled the glands of Lieberkuehn. This comprises the earliest case of intestinal actinomycosis. The fungus slowly burrows through the wall of the intestine producing ulcers that vary in size from 2 millimeters to 2 centimeters in diameter. As it advances it infiltrates all tissues with which it comes in contact. At a later stage in the intestinal type of disease, there are undermined ulcers with a base of muscularis showing a defensive zone of fibrosis which follows in the wake of the invading organism. This is indicated by the scarring and healing of the mucosa even before the disappearance of the organism, as mycelium has been discovered in the indurated wall of the gut with a mucosal scar showing where the streptothrix had entered. This cicatrization is often seen as dense cord-like tracts of new connective tissue, connecting the old with new foci of invasion. In front of the organsim as well as behind it, there is considerable reaction, the peritoneum becomes active as soon as the fungus is through the mucosa, and adhesions begin to form with thickening of the outer wall of the gut and matting down of the adjacent structures, thus erecting a barrier against further progress of the parasite. However, the organism continues to infiltrate, progressing through the adhesions and burrowing deeply into every new structure which lies in its path. The anatomical relationship of the pelvic genitalia naturally places them in precarious territory and the added stimulus of a fresh operative field only makes ovarian or pelvic involvement a greater possibility. This typical progressive involvement is explained by Hinglais who states: "The fungus introduces itself into the cells from without, inward, then perforating their walls from within outward, the filaments of the fungus place themselves in contact with other cells that they in turn penetrate." Continuity, although not the only method, is perhaps the

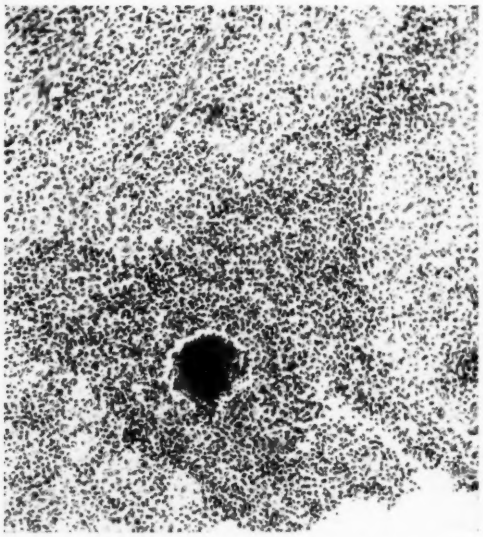

Fig. 3. Low power photomicrograph of an actinomycotic colony showing typical club formations embedded in an abscess.

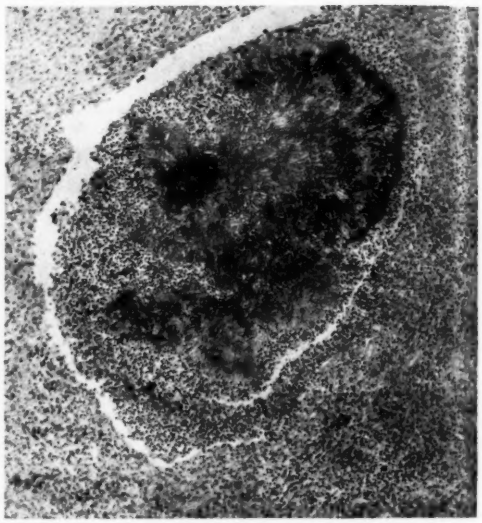

Fig. 4. Low power photomicrograph of a larger colony showing the characteristic arrangement and location.

greatest single factor in the spread of the infection. Blood dessemination is likewise of importance and may, as mentioned by Robinson, bring about disastrous metastasis by vascular infiltration. The lymphatics play a very minor rôle, Partsch, Kaufmann, and Grill even denying such a possibility, claiming that those cases in which such involvement is noted are merely tissues which lie in the path of invasion.

Woman, age 26; occupation, housewife; complains of bowel trouble and painful defæcation. She has never worked on a farm and has never been associated in any way with live stock. Four years ago she had an attack of appendicitis, the history of which is rather vague. She was operated upon and the appendix was removed. Unfortunately, the appendix was not saved by the surgeon and no microscopic study of it could be made. Following this, she had an unusually prolonged convalescence, the wound drained a large amount of yellowish purulent material and her physician at the time was apparently much impressed with the duration of the drainage and its character. Nothing specific concerning the bacteriology of the purulent material could be obtained. The drainage lasted approximately 6 weeks, the wound healing very slowly and leaving a large ugly scar. She was practically symptomless until 2 years ago, when she had menorrhagia lasting 6 weeks accompanied by pain in her right side. She has had leucorrhœa for 18 months. She is married but has never been pregnant. The menses have been normal.

Present illness. The "bowel trouble" with painful defæcation started a year prior to entrance into the hospital, when she had a severe pain in her bowels and passed some blood in her stool. She remained in fairly good health until a week prior to her admission when she again had a severe pain in the abdomen, was markedly constipated, and passed some more blood per rectum. The constipation has since been followed by diarrhœa and agonizing pain upon defæcation.

Physical examination. Aside from a palpable and tender thyroid, the examination of the head, neck, and thorax was essentially negative. The abdomen showed a rough, indented, irregular scar 3 inches long at McBurney's point. There was marked tenderness in the right lower quadrant and a mass of indefinite consistency was felt deep in the pelvis about 1 inch inside the right anterosuperior spine of the ilium. There was some tenderness in the left lower quadrant, but this was not nearly so marked as on the right.

Vaginal examination showed the cervix down and pointed to the left and backward. The fundus was anterior and to the left and was slightly tender. In the right fornix there was a mass the size of an orange which had the consistency of a soft fibroid. The cervix and fundus were freely movable. Rectal examination revealed the presence of hæmorrhoids. Red cell count was 4,400,000; white blood cell count, 13,000; hæmoglobin, 80 per cent; polymorphonuclear leucocytes, 76 per cent.

Operative findings. The abdomen was opened through a right rectus incision at the site of the old scar. The peritoneal fluid was increased. The uterus was anterior and pushed slightly to the left by an irregular tumor mass which was apparently arising from the right ovary. This tumor mass was about the size of a lemon, it was very hard and matted down to the adjacent pelvic structures with very dense, old, fibrous adhesions. The left ovary was normal and the left tube was somewhat dilated and appeared to be filled with fluid. The tumor in the right fornix was dissected carefully from its dense peritoneal and pelvic attachments leaving a very rough irregular nodular mass connected to the right tube which was likewise markedly thickened and covered with dense adhesions. The appendiceal stump was surrounded by a dense mass of adhesions attached to the scar and surrounding pelvic structures. After the infundibulopelvic ligament was clamped about 1 inch from the uterus, the tissue was cut and the distal portion of the tube and the tumor were removed together.

Gross pathology. The material removed at operation consists of an irregular inflammatory mass made up of a tube flattened out on what apparently appears to be a very markedly enlarged and distorted ovary. This mass is covered with adhesions. It has a mottled, yellowish red color and the ovarian portion has a nodular appearance and seems unusually hard and woody in consistency. The tube is enlarged, its walls are thickened, and it measures from 10 to 15 millimeters in diameter. Its surface is congested and shows some hæmorrhagic adhesions, its distal end is matted down with the remainder of the inflammatory mass but its fimbriated end is open. On section the epithelial folds appear thickened and somewhat flattened out and the lumen contains a small amount of pale yellow, rather viscid, purulent exudate. The remainder of the inflammatory mass, apparently representing an enlarged ovary, measures 7 by 5 by 4 centimeters and presents a very rough bosselated hæmorrhagic surface covered with tough, fibrous, ragged, and hæmorrhagic adhesions. This mass is unusually hard and tough in consistency and cuts with great resistance, the cut surface presenting a wormeaten appearance with numerous, round, and irregular anastomosing pockets of pus separated by dense masses of hard, indurated, connective tissue. These interlacing pockets of pus contain a pale yellow, viscid, purulent exudate that is easily expressed on the surface. No typical canary colored granules or gray flecks are seen in this material. Smears from the exudate fail to show a streptothrix or any other organism.

Histological pathology. The tube shows marked thickening of its wall, there being hypertrophy of the muscle tissue and considerable hyperplasia of the epithelial folds. Some of the latter show fusion of their free ends producing a pseudo-glandular appearance. There is some proliferation of the epithelial cells and likewise considerable infiltration with mononuclear cells in the stroma of the folds. No polymorphonuclear leucocytes were seen. Near the outer edge of the tube there is a small area surrounded by a fibrous tissue capsule containing granular necrotic tissue in the center enclosed by epithelioid cells. In this necrotic tissue there are irregular cleft-like spaces as would be produced by the solution of cholesterol crystals.

None of the sections show ovarian tissue. Sections through what is evidently the ovarian mass show nothing but irregular, acute, and chronic inflammatory foci separated by more or less heavy bands of hyaline fibrous tissue. Some of these inflammatory foci are rather large and contain abundant pus and are lined by acute granulation tissue in which there are all types of leucocytes, particularly large mononuclear, lymphoid, and plasma cells. Fibroblasts are numerous. The amount of tissue reaction surrounding the purulent foci is variable. At no place do the pockets of pus and dense fibrous tissue masses extend into the wall of the tube. The type of leucocytes in these foci is likewise variable. In the largest purulent foci occasional typical eosin staining, radiating, mycelial structures characteristic of actinomycosis may be seen. These show clubbed endings and are surrounded by a zone of polymorphonuclear leucocytes beyond which the mononuclear leucocytes become relatively more numerous. Some of the colonies of fungi show the characteristic eosin staining clubbed endings radiating in a fan-like manner from a central finely granular fibrillar matrix. Many mononuclear phagocytes are scattered in the purulent foci. The Gram stain fails to show characteristic Gram positive filaments. The acid fast stain is negative. A preparation stained with Van Giesen shows the mycelial masses staining in a characteristic manner.

In addition to the cases reported in the table there were 6 others, 5 cited by Hueffer and 1 by Rosenstein, which were not incorporated in the foregoing list because the information was too scanty and the original sources inobtainable.

The 5 cases cited by Hueffer are as follows: Brandenstein's case was an involvement of the parametrium with origin in the appendix, Illich's case was an involvement of the adnexa with the primary focus in the intestine, Hedinger's was of the tubes and of unknown origin, and those of Taylor and Fisher, and Toennies both involved the right ovary the former being of unknown origin and the latter arising from the intestine. Rosenstein cites the case of Giordano which is likewise listed by Robinson; this was an involvement of the uterus and is said to have been primary in the skin.

TABLE OF REPORTED CASES

Name	Age	Date	Location	Origin	Diagnosis*			Symptoms	Operation	Duration	Autopsy	Prognosis**	Remarks
					A	B	C						
Zemann	50	1883	L. ovary	Intest.	X	X	O	Fistula at umbilicus.	O	5 mos.	X	D	Uterine adnexa are united in a fistulous mass.
Zemann	40	1883	R. tube		X	X	O	Gastric distress, anorhexia, fever and vomiting.	O	14 das.	X	D	Purulent meningitis. Cheesy mass in right ovary and uterus.
Zemann	30	1883	Parametrium	Rectum	X	O	O	Persistant diarrhœa, pain in the abdomen with tumor.	X	3 mos.	X	D	Perforation of bladder and rectum.
Bostroem	32	1884	Ovary	S. intest.	X	O	O	Vomiting, constipation, abdominal colic.	O	4 mos.	X	D	Fistula between small intestine and suppurating right ovary.
Samter	36	1892	Parametrium	S. intest.	X	X	O	Periods regular, pain in abdomen and hip, chills.	X	6 mos.	O	D	None.
Samter	35	1892	Parametrium	S. intest.	X	X	O	Following birth of child, pain, fever and swelling left leg. Menses regular.	X	6 mos.	O	D	None.
Samter	26	1892	L. ovary	Rectum L. intest.	X	X	O	Periods irregular, abdominal pain, tumor, anorhexia and weakness.	X	2½ yrs.	X	D	Peritonitis, abscess of liver, rectal fistula
Rechtenbacher	19	1893	Uterus Adnexa	Skin	X	O	O	Postoperative tumor in the left hypogastrium.	X	1 yr.	X	D	Perforated bladder, pus in cul-de-sac.
Stewart and Muir	35	1893	Both ovaries	S. intest.	X	X	O	Shooting pain, region right kidney, symptoms of peritonitis.	O	10 mos.	X	D	Typical hepatic abscesses, vagino-ovarian fistula.
Habel	45	1895	Both ovaries	Vagina Uterus?	X	O	O	Dementia. Six years prior had an inflammatory process in cæcum.	O	6 yrs.	X	D	Recto-ovarian fistula.
Geldner	15	1899	Both ovaries	Hip	X	X	O	Pain in the left hip, soft swelling in the right lower quadrant.	X	11 mos.	X	D	Cæcum and small gut adherent to pelvic organs.
Litten	39	1900	R. ovary	Liver	X	X	O	Ascites, death following paracentesis. Drainage through abdominal wall.	X	1 yr.	X	D	Liver abscesses, dental caries, ovary only other focus.
Fehmers	?	1901	Parametrium	Appendix	O	X	O	Menses normal, pain and tumor in the lower abdomen.	X	6 mos.	X	D	Rectum eroded and perforated, pelvic organs matted together.
Fehmers	?	1901	Parametrium	Appendix	X	X	O	Typhoid 3 months before illness. Two children.	X	7 mos.	O	I	Fistula into cellular subperitoneal tissue of iliac fossa.
Hart and Berry	49	1902	L. ovary	Unknown	O	X	O	Married, no children, weakness, bearing down pains in the pelvis.	X	18 mos.	O	I	Numerous periappendiceal adhesions.
Henriot	21	1902	L. adnexa	Appendix	X	X	O	Constipation, recurrent pain in the abdomen, starting in the right side.	X	5 mos.	X	D	Multiple actinomycotic abscesses of uterus, lumbar and pelvic muscles.
Rosenstein	17	1904	R. ovary Tube	Appendix	X	X	O	Amenorrhœa 12 months' duration, typical history of appendicitis.	X	3 mos.	O	I	Exploratory operation showed large suppurating ovarian cyst?
Schlagenhaufer	38	1905	Tube Ovary	Jaw	X	X	X	None given.	O	? yrs.	X	D	Abscesses in lung, pleura, peritoneum liver, spleen, and ovary.
Schlagenhaufer	18	1905	L. tube ovary	Rectum L. intest.	X	X	X	None given.	O	?	X	D	Actinomycotic abscesses in liver tube, ovary, and rectum.
Verocay	14	1905	Uterus Adnexa	Rectum?.	X	X	O	Amenorrhœa for 4 months, painful abdominal tumor.	O	4 mos.	X	D	Rectal ulceration, cheesy mass involving all pelvic organs.
Hamm	39	1906	Tubes	Unknown	X	X	O	None given.	X	13 yrs.	O	I	Numerous pelvic adhesions.
Neuhauser	60	1906	Uterus R. ovary	Appendix	X	O	O	None given.	X	?	O	I	Cheesy masses in uterus and right ovary.
Hamm & Keller	34	1909	Uterus Ovary	Intest.	O	X	X	Six years prior operated for tbc? adnexa, followed by abdominal fistula and development of tumor.	X	6 yrs.	X	D	Recto-uterine fistula, peritonitis following last operation.

*Basis of diagnosis: A—gross demonstration of granules; B—histological demonstration of organism; C—bacteriological demonstration with successful cultivation.
**Prognosis: D—died; I—improved.

TABLE OF REPORTED CASES—Continued

Name	Age	Date	Location	Origin	Diagnosis*			Symptoms	Operation	Duration	Autopsy	Prognosis**	Remarks
					A	B	C						
Bondy	28	1910	Adnexa	L. intest.	X	X	O	Amenorrhœa 1 year, pain in right lower quadrant, especially on urination or defæcation.	X	8 mos.	X	D	Communication best seen in tumor and ascending colon.
Wagner	19	1910	Both ovaries	Appendix	O	X	X	Difficulty in defæcation.	X	7 yrs.	O	I	Tubal involvement.
Shaw	38	1910	L. ovary	Appendix	X	X	O	Acute appendicitis, periappendiceal abscess followed by right inguinal swelling 1 year later.	X	1yr.	O	D	Patient died of septicæmia?
Wunshik	38	1913	Both ovaries	Unknown	X	X	O	Periosteitis alveolaris with drainage 4 years prior. Abdominal pain. Menses normal.	X	5 yrs.	O	I	Both ovaries involved, dense pelvic adhesions, tubes free.
Kohler	33	1914	L. ovary	Vagina Uterus?	X	X	X	Menses normal, pain in left side and leg, onset after labor, abortion of 23 cm. fetus.	X	3 mos.	X	D	Abscesses liver, spleen, ovary.
Robinson	15	1919	Ovary Tube	Meso-sigmoid	O	X	O	Early onset of amenorrhœa.	X	8 mos.	O	I	Typical wormeaten ovary.
Hueffer	40	1922	Uterus	Sigmoid colon	X	X	O	Twelve children. Twelve months before last delivery pain and tumor in the hypogastrium.	X	10 wks.	O	I	Wormeaten uterus, organisms very numerous.

*Basis of diagnosis: A—gross demonstration of granules; B—histological demonstration of organism; C—bacteriological demonstration with successful cultivation.
**Prognosis: D—died; I—improved.

An interesting deduction is the fact that the intestine is seen to be the origin in 20 of the 30 cases listed, which lends considerable support to the hypothesis of Wolff and Israel, especially since the source of the remaining 10 cases is either debatable or of unknown origin. This phase of the subject has been discussed rather extensively by Hueffer who questions all cases reported as occurring by way of the vagina and uterus.

The ovaries alone were involved in 12 instances, the parametrium in 5, the ovaries and tubes in 4, the tubes alone in 4, and combinations of the tubes, ovaries, uterus, and adnexa make up the remainder of the cases.

Most of the cases occurred during the childbearing period and the duration of symptoms ranges anywhere from 2 weeks to 13 years, the majority of cases being from 3 months to a year.

DIAGNOSIS

Even during laparotomy the condition may not be easily recognized. As in the present case, the surgeon often suspects that he is dealing with a neoplasm until the pathological report fails to confirm his deductions and even then the etiology may not be definitely determined until the fungus is demonstrated. The pockets of pus containing the sulphur granules said to be so characteristic of ray fungus infection are not always in evidence to assure the surgeon, and gross examination alone may be entirely insufficient. Actinomycosis is primarily a tumor with the structural resemblance of a neoplasm, but being essentially inflammatory, search for the elements of inflammation is imperative. Microscopic examination often fails to bring out the fungus immediately and, in the absence of the canary colored granules, the diagnosis may remain doubtful. Patient search, however, will usually yield at least one characteristic organism with the radiating clubs. Fortunately, in the case under discussion the streptothrix was suspected and one organism was found in the first few sections cut with parrafine, although other organisms were not found until a very large number of sections had been made. Hæma-

toxylin and eosin, Gram, or Van Giesen stains may be used and all bring out the clubs sufficiently to make the diagnosis. A smear of the pus stained by the Gram method often shows gram positive filaments that are almost pathognomonic. The irregular pockets of pus with old sinuses separated by dense hyaline fibrous stroma, associated with the presence of polymorphonuclear leucocytes, surrounded by mononuclear cells should always suggest the possibility of an actinomycotic infection, but demonstration of the typical fungus colony with its radiating clubs is necessary for an absolute diagnosis.

Much has been written concerning the clinical importance of a differential diagnosis in these cases, the consistency of the tumor mass and numerous points in the history being cited as of extreme diagnostic significance. From the signs and symptoms presented in a review of the reported cases, however, one must conclude that there is nothing of great importance in the realm of objective or subjective findings aside from actual demonstration of the streptothrix in a suppurating lesion, to which one might attach any importance. Previous history of appendicitis with operation and an unusually slow and stormy recovery might make one suspicious, especially if the condition under consideration came on at some time after the intestinal involvement had apparently been relieved. The organism is slow in its infiltration and slow in producing symptoms. Schlegel reports a number of cases of actinomycosis of the jaw in which, after infection the symptoms did not become manifest for over 2 years. He likewise found dry spores germinated even after 238 hours of direct exposure to sunlight.

Robinson lays some stress upon the early onset of amenorrhœa in the ovarian type of the disease, but a review of the literature fails to justify this deduction. Tuberculosis can usually be ruled out by the temperature curve and concomitant lung findings and malignancy by the lymphatic involvement.

PROGNOSIS

There is a variance of opinion as to the prognosis in these cases. All of the earlier cases died and most writers place the mortality very high. In case secondary bacterial invasion takes place it is stated by Grill that the patient may spontaneously recover, as the actinomycetes are very susceptible to bacteria and are killed off by them. This would indeed appear to be the case when one views the pathological picture produced by the fungus. A slow worker, a prolific fibrin producer and the tendency to the formation of permanent adhesions would label the organism as one of mild virulence (Hertzler). Every case is, however, an entity in itself and when complete surgical removal is impossible with an uncomplicated infection, it may be stated with assurance that the prognosis is extremely bad.

TREATMENT

Early surgical intervention with an attempt to remove all of the diseased tissue is, of course, the only procedure. Potassium iodide has long been considered the classical therapeutic agent, but many cases of the abdominal form of the disease fail to respond to its use.

The author wishes to express his appreciation to Dr. Don Carlos Guffey for his assistance and kindness in the use of his material and records.

NOTE.—Since this paper was written three cases of ovarian actinomycosis have appeared in the literature. T. Schmidt (Zentralbl. f. Gynaek., 1924, Jan. 12) reported a case of right ovarian involvement in a woman 45 years old. Later S. Mitra (Ztschr. f. Geburtsh. u. Gynaek., 1924, lxxxviii, No. 2) reported another case in a woman 49 years old with involvement of the right ovary, parametrium, and cervix. The latest case is that of Walter Brickner (Ann. Surg., 1925, lxxxi, No. 1) wherein he tells of a girl 18 years old with actinomycosis of the right ovary, who following several operations had apparently recovered. The patients of Schmidt and Mitra both died after operation. The origin in all three might be traced to the intestinal tract.

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CARTILAGINOUS TUMORS OF BONE

By VIOLET H. KEILLER, A.B., M.D., Galveston, Texas
From the Laboratory of Surgical Pathology, University of Texas, Galveston

IT is the purpose of this paper to describe in detail a selected group of cartilage containing tumors of bone, with a view to determining, if possible, those features which enable one to state the benign or malignant character of the particular growth under consideration and, to a limited extent, the relative degree of malignancy.

The writer is aware of the pitfalls surrounding the term "degree of malignancy." There is, however, a very definite group of tumors of other organs than bone which metastasize late or not at all, but which show definite infiltrative and destructive tendencies. These tumors are prone to recur. Such recurrence is explained by the fact that while they appear in many instances to be encapsulated or to be fairly sharply limited in extent, the outlying cells penetrate to a much greater distance from the primary focus than is obvious to the naked eye. They do not, however, tend to cause vascular embolism nor lymphatic extension and the distant metastases so characteristic of malignancy are, therefore, absent. This group of tumors is recognized in epithelium as the "rodent ulcer," in subcutaneous tumors, as the "recurring fibroma" of the older surgeons. Pathologists have been in the habit of speaking of the group as "locally malignant." The term has its sphere of usefulness for it conveys to the surgeon very definite information as to his line of procedure. He must make a wide local extirpation removing a zone of apparently healthy tissue as in a malignant tumor, but he need not remove glands, nor need he fear metastasis to internal organs. It is a recognized fact that certain of these tumors after irritation (by incomplete removal or other trauma) may take on more rapid growth. In time they may even change their character completely, giving rise to a malignant process capable of metastasis. They present then a histological picture which differs from that of the original condition. The transfer from one type to another is no more remarkable than is the change from irritative premalignant epithelial hyperplasia to cancerous invasion. It is probable that both are the result of a disturbance of the biochemical balance that controls mitosis and cell differentiation. If the writer understands correctly the terminology used by the Bone Tumor Registry, the expression "borderline tumor" is used to replace that of "locally malignant" when such tumor arises in bone. This term probably conveys more accurately the meaning of the pathologist and is advantageous in many ways.

In all tissues the determination of these "borderline" cases tests the skill of the pathologist. Definitely encapsulated benign tumors, in which all cells have attained adult development with the production of the normal end products of such cells are easily recognized. Similarly, complete departure from the normal on the part of most or many of the proliferating cells, with evidence of atypical mitosis, gives the characteristic picture of extreme malignancy, and is easily recognized. In such definitely benign or definitely malignant conditions both gross and microscopic diagnosis present no difficulties. The value of pathological diagnosis lies in the recognition in obscure cases of the benign or malignant character of the growth. Probably the greatest difficulty encountered is in the histological distinction between embryonic cells which are incapable of producing adult end products, or of attaining in other respects the appearance of adult cells, but are harmless enough, and cells which have lost all growth restrictions, even though they may retain to a certain extent the capacity to produce the normal end product. As applied to osteogenetic tumors this means that differentiation is easily made between the benign tumor composed of firm, well developed cartilage or of definite osseous tissue, as opposed to the malignant tumor of soft, vascular cartilaginous or osteoid stroma. Between these two

types lies a group of tumors, in which no such extremes are present. The difficulty here will lie in the uncertainty of the fate of certain proliferating cells. These cells may appear at the time the growth is removed and the section taken to be embryonic in type, incapable of further differentiation and fashioned for one end only, namely further proliferation. Had they continued to live, they might in due course of time have gone on to adult function. Embryonic tissues, rapidly proliferating and almost undifferentiated are hardly recognizable as tissues except by a knowledge of their topographic relations. The distinction is not easily made between normal purposeful young cells proceeding "on their lawful occasions" and purposeless young cells having no law. The writer is convinced that in any tissue the inability to produce its adult end product is an indication of defective chromatic content, and is of itself a danger signal.

Too little attention has been directed toward the histology of bone repair. Histologists believe that in the formation of bone from cartilage, the cartilage cells never become bone cells. They are destroyed by the process of absorption which destroys the matrix, and new bone cells originate from specialized periosteal buds to take their place. Histologists believe also that cartilage cells which have once become inclosed in lacunæ, become incapable of reproduction. This is also true of adult bone cells. Bone repair consists first in the formation of fibrous tissue, and subsequently replacement of fibrous tissue (not transference of it) by osteoblastic ingrowths. Cartilage formation, unless it be from embryonal cartilage as it occurs in youth, takes no part in the usual healing of bone lesions. The apparent cartilage cap in ununited fractures will be found on examination to be in the vast majority of cases dense hyalinized connective tissue such as is found in other scars. This is true in the vast majority of cases; exceptional cases do occur in which cartilage is formed as a preliminary to callus. More accurate information on the frequency and etiology of this form of bone repair is urgently required.

With the present limited knowledge of bone pathology it appears unwise to discard entirely the "tissue terms"—such as "chondrosarcoma," "myxosarcoma," etc., while there is no clear conception of the mechanism of the production of stroma. It is true that the cells, and not the intercellular substance form the basis of diagnosis. But are not the functions of these cells, perverted or otherwise, a clue to the nature of the cells? "By their works ye shall know them." In the present status of bone pathology, the pathologist who would disregard the formation of intercellular substance is discarding the ladder when he has climbed to the third rung. It is well for him to recognize that he has not yet reached the top.

With this explanation the writer ventures to offer this study of cases in which the intercellular substance is to a greater or less extent cartilaginous in the hope that certain characteristics of this limited group of cells may be clarified.

In this paper no account is taken of the cartilaginous tumors which contain bone. In these the osseous structures either replace cartilage or develop synchronously with it, and constitute a separate problem. Cartilaginous tumors containing myxoma are discussed in the belief that myxoma is a phase of cartilage formation. This belief is founded on the idea that chondrin and mucin are essentially the same. Both these varieties of so-called "intercellular" ground substance are laid down in the embryo in the same manner. The mesenchymal cells, the forerunners of all connective-tissue cells, after active proliferation, unite to form a syncytium. The protoplasm of the syncytium increases until the nuclei are widely separated. The protoplasm then becomes differentiated into a granular endoplasm, surrounding the nuclei and forming the future cell bodies, and a hyaline ectoplasm. This ectoplasm remains as the ground substance of all forms of connective tissue. The shrinkage due to fixation in ordinary histological preparations, makes it appear extracellular. Mucous ground substance is identical with the ectoplasm in its original semifluid state; the more solid chondro-mucin represents the same ectoplasm, altered by concentration and other chemical changes. This relationship offers a reasonable explanation of the fact that with very rare

exceptions cartilaginous tumors contain either myxoma, or mucoid degeneration, or both.

CASE 1. Excessive cartilage formation in callus. S. P. 2744. Male, white, age 30 years. A little over 4 months ago the patient fell from a height landing on his shoulder and striking the clavicle about its middle. He was unable to move the arm. A very clear X-ray of the clavicle showed no evidence of injury to the bone. The patient says that he had electrical treatments for 6 weeks. He was able to work a little after this time, but still had pain. Four weeks ago he first noticed a swelling of the middle of the clavicle and a grinding sensation on moving his arm. Twelve days ago he came to the John Sealy Hospital, Outpatient Clinic, for treatment on account of the increasing swelling and pain. X-ray at this time showed a fracture of the clavicle, surrounded by a spindle-shaped area of decreased density. The periphery of this area especially laterally, was irregularly calcified, forming an indefinite bony shell. The X-ray appearance was less clear cut than in the usual benign giant cell tumor, but the clinical examination was strongly suggestive of this. The tumor was easily palpable, firm, and smooth. The skin moved easily over it; was slightly reddened, but not œdematous or tender. Deep pressure produced slight crepitus and pain in the tumor. X-ray 2 days before operation showed no change as compared with that taken 10 days before. Wassermann was negative.

Operation was performed by Dr. J. E. Thompson through an incision along the line of the clavicle. Vascular spongy bone was exposed and opened. The cortical bone was so soft as to be easily removed with nibblers, the marrow cavity was small, and filled with partly calcified tissue. At a distance of about 5 centimeters from the sternoclavicular articulation a fracture was present. The end of the medial fragment was conical as though by erosion and embedded in a zone of dense cartilage 0.5 to 1.0 centimeters in thickness, which laterally merged with the new vascular bone formed around the lateral fragment. The peculiar erosion of the medial fragment, the excess of cartilage, and the fact that the fracture was not shown in the roentgenogram taken after the injury, all seemed to point to a tumor growth, probably malignant. The affected portion of the clavicle was excised, with the intention of completing the operative removal of the bone if the sections showed sarcoma.

Pathological examination. Many decalcified sections were made from different portions of the tumor. These show young, highly vascular granulation tissue, actively proliferating bone, and cartilage. It is the cartilage that especially merits attention. Rarely does one find even in children any great production of cartilage as a part of normal bone repair. In the majority of specimens of callus, bone is formed by replacement of fibrous tissue, especially in situations at some distance from the epiphyseal line. In the case under consideration dense cartilage has formed, and the medial part of this is but slightly calcified and not at all ossified. Laterally both endochondral and periosteal (membranous) bone are being produced.

There seems to be no doubt that fracture was not produced by the initial injury. The symptoms, however, dating as they do directly back to a heavy blow, indicate that rather severe traumatism occurrred at that time. The writer offers the explanation that the injury stimulated a reaction on the part of the periosteum which responded not only by the normal production of bone, but of cartilage and that this cartilage gradually encroached upon bone until it so weakened the shaft that fracture occurred. The boundary line between such an irritative hyperplasia and neoplasm is none too definite. The excessively active growth of bone and cartilage seen here, suggests that malignant change might easily occur, were the bone subjected to further irritation. When one recalls the frequency of a history of injury preceding the development of bone sarcoma, this active growth acquires new significance.

X-ray examination of this patient made 3 months after operation shows the formation of dense callus in the clavicular defect.

CASE 2. Subperiosteal epiphyseal chondroma. S. P. 2506. Male, white, age 20 years. Eleven months ago the patient fell from the rigging of a ship and injured the toes of his right foot. Two months later he noticed a swelling between the bases of the second and third toes. This has gradually increased in size until the pressure of a shoe has become painful. Examination shows a rounded tumor over which the skin moves freely, attached to the base of the proximal phalanx of the third toe. Pre-operative X-ray was not made. The toe was amputated by Dr. N. Andronis, as this procedure seemed to offer the shortest period of disability, and nothing was to be gained by re-section. Six months after the operation the patient was examined; there was no recurrence. X-ray of the amputated specimen shows erosion of the phalanx by a tumor containing a very small deposit of lime salts in its proximal portion, better shown in the lateral view.

Pathological examination. The tumor, measuring 2.5 by 2 by 2 centimeters arises from the side of the proximal phalanx. It is covered by a thin fibrous capsule, which is continuous with periosteum, no bone shell separates this capsule from the tumor tissue. The fresh tissue is milky white, almost avascular, of the consistency of junket; it feels slimy to the finger, but is not cystic. On section it gives a

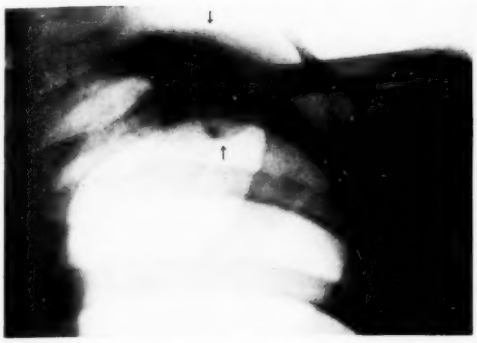

Fig. 1. Case 1. Cartilaginous and osseous callus following mild traumatism to the clavicle. Spontaneous fracture through the cartilaginous area.

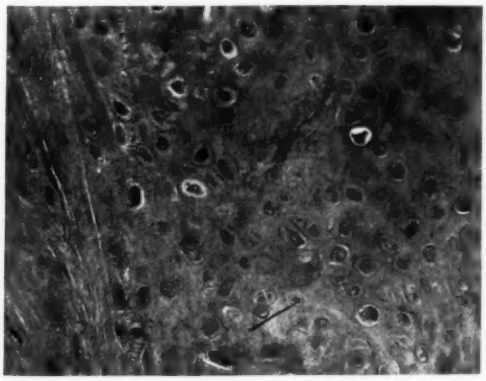

Fig. 2. Case 1. Area of rapidly proliferating cartilage in the callus found in the specimen taken at operation from the clavicle.

slight sensation of brittleness, but not that of adult cartilage.

Microscopically the tumor is found to be more vascular than it appears grossly. The blood channels are invariably lined by endothelium. Many of the vessels even of fair size have no wall except this endothelial layer, but in many a more or less definite fibroblastic layer is present. These better formed vessels are carried in loose areolar connective tissue trabeculæ. Many of the simpler endothelial lined spaces lie in trabeculæ of young fibroblasts having a matrix which is almost homogeneous and which is in some areas, suggestive of myxoma. The cells of these areas appear in many instances to blend with the surrounding tumor cells. Occasionally a blood channel is found in the midst of a tumor area without intervening connective tissue trabecula and lined solely by an endothelial layer. The tumor tissue is composed of very irregular cartilage. Portions show a tendency on the part of the cells to line up in rows suggesting the arrangement of the cartilage in developing endochondral bone. Many of the lacunæ here are large, and the cells contained within them have large œdematous cell bodies, and rather small pyknotic nuclei. In some areas the fusion of numbers of these dilated lacunæ has resulted in the formation of small cysts in which an occasional cell lies entangled in the interstices of œdematous mucoid matrix. In other areas small spaces between the cartilaginous areas appear to be filled with true myxomatous tissue with stellate cells, having large pale resting nuclei. The mucoid areas are frequently difficult to distinguish from the myxomatous, but the character of the intercellular substance in the latter is homogeneous and not interspersed with the fibrillæ representing the remnants of the more solid cartilaginous matrix, and the cells of the myxoma are living—neither their nuclei nor their cytoplasm show degenerative changes. In this tumor there are adult cartilage cells, embryonal cartilage cells, and myxoma cells. There are no evidences of atypical mitoses. The tumor, at this time in its history, is a benign lesion; but it differs potentially from the dense ossifying or hyaline chondroma in which gross and microscopic pictures conform to the structure of adult cartilage.

Case 3. Central epiphyseal myxochondroma. S. P. 2141. Female, white, age 12 years. Eight months ago the patient thinks that she "sprained her ankle." There was lateral swelling, but little pain, no discoloration of the skin, no tenderness. Gradually she began to notice a dull aching pain in the ankle; the swelling increased especially after active exercise, and the pain became increasingly noticeable. Two months later she consulted a physician, who advised a brace, as she now turned the ankle very easily. Pain continued and swelling was present even when she rested the leg. One week before operation she had marked access of pain, especially severe at night, and the ankle became red, and very tender. She was taken to the Temple Sanitarium and an X-ray made. This showed enlargement of the lower end of the fibula, just above the epiphyseal line, with a cystic formation in the interior of a thin apparently unbroken bone shell. Examination was negative except for the tumor; movements of the ankle joint were free and painless. Slight tenderness was present over the tumor area.

Operation was performed by Dr. G. V. Brindley. An incision was made laterally over the fibula; a fusiform swelling of this bone was found, from which the periosteum stripped easily. An exploration was done through a window in the bone shell and a cyst entered full of thin mucoid material, and lined by cartilage. The cystic area was resected with the contiguous bone; leaving a small strip of the posterior part of the shaft intact. The wound was closed without drainage. Recovery was uncomplicated and the girl is free from recurrence 25 months after the operation.

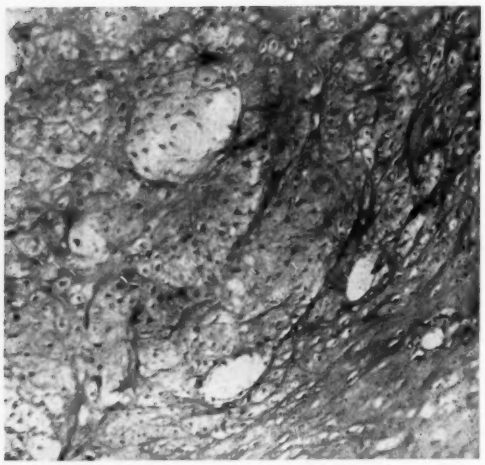

Fig. 3. Case 2. Showing the transition from embryonal cartilage cells to true myxoma in a tumor without degenerative changes.

Pathological examination. Through the courtesy of Dr. Brindley, the specimen was presented to the Surgical Pathology Museum of the University of Texas. The mucoid contents have flowed out, so that the tumor as preserved shows a cyst, covered laterally by a very thin osseous wall and by periosteum. Within this is a thin shell of fairly solid cartilaginous tissue. Microscopically, the periphery of the tumor shows very active osteoblastic growth, with destruction of the inner bone lamellæ, such as one finds in the bone shell about central giant cell tumors. The subperiosteal proliferation of bone forming elements is so active as to excite suspicion, yet this is no part of the neoplastic process, but an effort to wall this off, a repair phenomenon. Within this osseous covering an inflammatory fibroblastic zone imperfectly separates tumor from bone lamellæ. The cartilaginous shell of the tumor presents in certain areas imperfect lacunar formation; most of it, however, is composed of stellate cells, lying in a chondromucinous intercellular substance. In different portions of the tumor one finds all stages in structure between embryonal cartilage and mucous connective tissue. In the more mucoid areas the long cytoplasmic processes of the stellate cells appear to communicate with one another so as to form a syncytium. Mitotic figures are occasionally seen; they are not atypical. Blood vessels in the interior of the tumor are rare; those that are present lie in strands of young fibroblastic tissue, the peripheral cells of which appear to pass into the stellate tumor cells. An occasional foreign body giant cell is present, surrounded by a clear space in the matrix. The whole microscopic picture of this tumor shows greater cellular activity than the preceding case, but without evidence of malignant transformation. The cells and the matrix are alike embryonal; the cystic condition of the interior of the tumor, together with the deficient blood supply, suggest that the peripheral cells alone obtained sufficient nourishment to remain active.

Case 4. Central myxochondroma with productive osteitis. S. P. 1552. Male, white, age 44 years. Four years ago the patient was struck on the thigh by a revolving pulley. The thigh was painful for some days but the patient did not have to stop work. He was then free from pain for about 2 months, but after that time commenced to have attacks of pain lasting 10 days or more. These attacks have become increasingly severe and frequent, until the patient is incapacitated. Various physicians have prescribed in the past year; treatment by salvarsan has been given without effect, though the patient says he has never had syphilis, nor a positive Wassermann. At the time he came to Dr. J. E. Thompson, blood Wassermann was negative; white cell count was 6,700; there was great pain and tenderness and slight enlargement of the upper third of the thigh. X-ray showed thickening of the shaft of the femur, very similar to that produced by osteitis fibrosa, or by syphilis, but the irregularity of the periosteal bone shadow, so frequent in syphilitic periostitis, was absent. There was some irregular rarefaction shown in the interior of the thickened bone; no sequestra were demonstrable. An exploratory operation was undertaken with the balance of opinion leaning in the direction of a chronic low grade infective process.

Operation was done by Dr. Thompson. The periosteum was slightly thickened but not acutely inflamed. It stripped with some difficulty, exposing porous bone, unduly hæmorrhagic, extremely thick but softer than normal. The medullary cavity for a distance of 12 to 15 centimeters was enlarged, and showed no fatty marrow. It was filled with thin almost colorless viscid material, which clung to the sponges, and had the appearance and texture of thick mucous secretion. A long window was made in the side of the shaft of the bone and the interior curetted. Most of the material removed was bloodless, but occasional small collections of black (old) blood were exposed. As the curette passed up and down the medullary cavity beyond the tumor area bleeding became very profuse. The interior of the bone was curetted as thoroughly as possible; the interior of the shaft was surrounded by spongy bone similar to that under periosteum and in striking contrast to the smooth "chicken bone" shell of the benign giant cell tumor. Fifty milligrams of radium were placed in the interior of the cavity and left in place eight hours. The wound was not packed. There was considerable reaction from the radium, but no infection.

Convalescence was satisfactory. One X-ray treatment was given before discharge from the hospital. The patient reported himself entirely well 2 years later. X-ray shows no recurrence three years after operation.

Fig. 4. Case 3. Cystic myxochondroma of lower end of fibula.

Pathological examination. Much of the material in the specimen in this case was so diffluent that it could hardly be disentangled from the gauze sponges. The material preserved for examination consisted of mucous tissue in which lay many small sago-like bodies. Microscopically these bodies proved to be areas of hyaline cartilage, having a few lacunæ with rounded or stellate cartilage cells with resting nuclei. Surrounding these cartilage areas are zones of pure myxomatous tissue with stellate cells; there are no mitoses present, and no evidence of active growth. The cells here are slightly more numerous than in the bulk of the tumor, which resembles the myxomatous material of the umbilical cord. In some areas the mucous intercellular substance is more dense and pseudofibrillated. The sections show occasional spicules of dead, partly decalcified, bone, surrounded by tumor cells, or by strands of connective tissue. The only blood vessels present within the tumor are carried in these connective tissue strands; they are endothelial lined channels. Some old and recent small hæmorrhages are present but no blood spaces lined by tumor cells, such as one may find in sarcoma.

Sections through the bone shell of the tumor show fibrous osteitis—a repair phenomenon. The inner layer of bone is penetrated slightly by myxomatous tissue, the cells of which appear to arise directly from the inner osteoblast layer, but there is no evidence in the sections examined of extensive penetration into the newly formed bone. The loose œdematous connective tissue trabeculæ lying between the bone lamellæ are easily confused with myxoma, but careful examination reveals the difference.

Contrasting this microscopic and clinical picture with that in the preceding case, one is impressed with the much slower growth, permitting such great bone hyperplasia that the inflammatory changes produced obscure the neoplastic character of the myxochondromatous tissues. The slow clinical course, the microscopic picture and the freedom from recurrence, after an operation known to be incomplete, indicate that despite the embryonal character of mucous connective tissue, the admixture of such tissue with chondroma is not of itself evidence of malignancy.

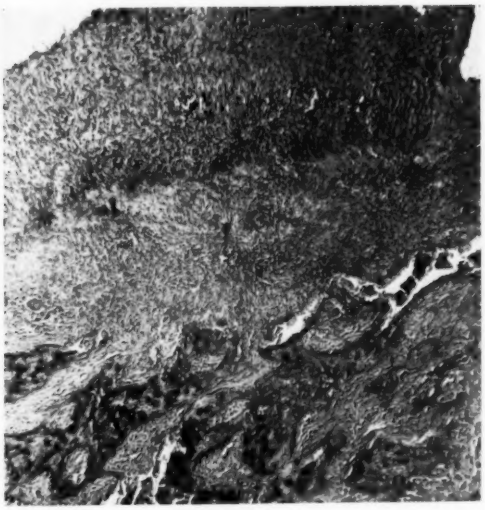

Fig. 5. Case 3. Showing the zone of inflammatory fibrosis between the bone shell and the tumor tissue.

Case 5. Peripheral chondroma with mucoid degeneration. Path. Mus. 1327. Male, white, age 30 years. The patient gave no history of previous in-

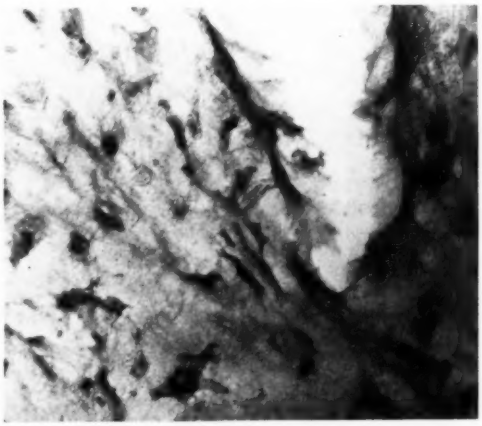

Fig. 6. Case 3. Myxochondromatous tissue forming the growing peripheral portion of the tumor. The interior is degenerated and cystic.

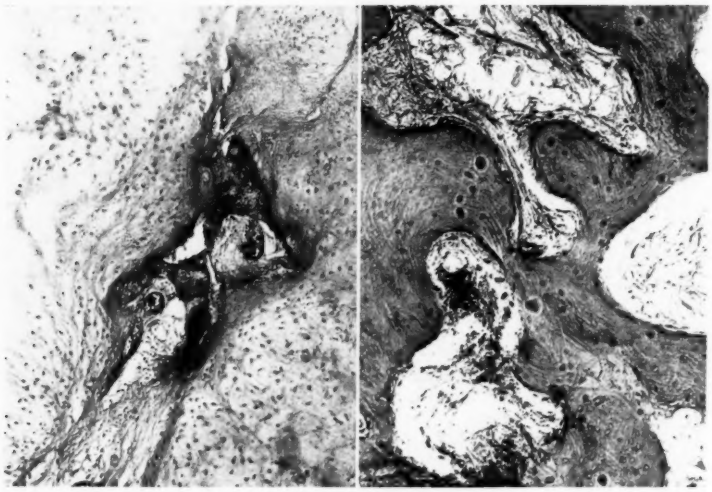

Fig. 7. Case 4. *A* (left), One of the sago-like bodies in interior of myxoma of femur. Strands of connective tissue bearing small vessels, surrounded by a zone of embryonal cartilage which passes peripherally into mucous connective tissue. *B*, Area of fibrous osteitis from the bone shell surrounding the tumor. This is a repair process, not a part of the neoplasm.

jury to the arm. A tumor mass, sharply defined, rounded, occupied the region medial to and slightly below the greater tuberosity of the left humerus; it was somewhat tender and by its size impeded free movement of the shoulder joint. The patient stated that it had been present about 4 years, and that it had been aspirated 3 years ago, and a small quantity of thin clear fluid withdrawn. On a clinical diagnosis of benign cystic chondroma, Dr. J. E. Thompson explored the tumor. It was found to be covered by a thick capsule of periosteum. At the base of this, where the tumor arose from the bone shaft a considerable peripheral zone of hard bone was present. The tumor tissue arose from the outer lamellæ of bone and was separated from the marrow cavity by the inner lamellæ. The bone deposited about its base appeared to be due to a repair reaction, as none was present in the tumor proper. The soft tissues were separated from the tumor capsule and it was chiseled away from its attachment to the humeral shaft. The patient is now well, 11 years later.

Fig. 8. Case 4. Showing the origin of the myxoma cells (at right) from the osteoblasts lying along a bone lamella on the periphery of the tumor.

Pathological examination. The soft, almost fluid, contents of the tumor have escaped and only a thin shell of cartilage remains attached to the capsule. This capsule is fairly thick, is not penetrated by tumor cells, and is continuous with the periosteum.

Microscopically, the tissues near the base of the tumor present a thickened periosteum, with lobules of dense adult hyaline cartilage. Over the greater part of the tumor, the zone beneath the capsule is composed of small, round, inactive cells, in a matrix of hyaline or fibrillar cartilage. This cartilage zone passes over into an area in which there is little staining reaction, the intercellular substance is fragmented and fibrillated, and toward the interior of the tumor gives place to a cellular mucoid degenerated material. This tumor is growing at its periphery only; even here it is growing but slowly. It is entirely benign. It grossly appears to contain myxoma,

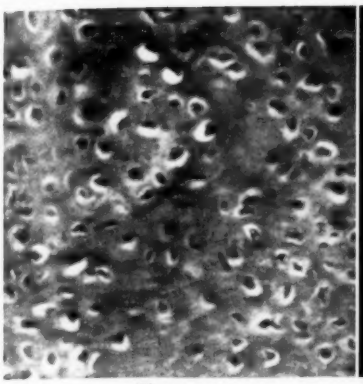

Fig. 10.

Fig. 9.

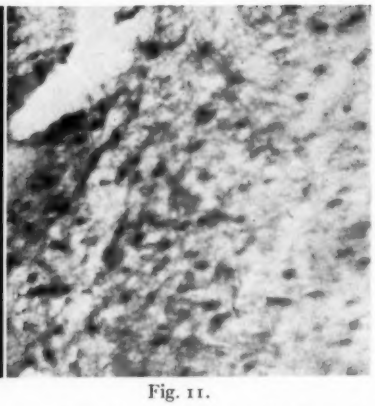

Fig. 11.

Fig. 9. Case 5. Peripheral encapsulation of a degenerated chondroma. No capsule separated the tumor from the shaft of the humerus, from which it arose.

Fig. 10. Case 5. Area of well formed hyaline cartilage.

Fig. 11. Case 5. Area of mucoid degeneration from the interior of a cystic chondroma, evidence of slow growth and defective blood supply. Cells and matrix are alike degenerated.

but histologically this is proven to be mucoid degeneration, furnishing evidence of slow growth, and defective blood supply.

CASE 6. "Borderline" myxochondroma, i.e. one of a low grade of malignancy. Path. Mus. 2255. Female, white, age 55 years. For more than 11 years a tumor had been present on the outer side of the head of the left tibia. The patient had but little pain or discomfort, and refused to submit to any operative interference until 8 years after the first appearance of a swelling. She then went to Rochester and was operated upon by Dr. Meyerding. Her physician says that Dr. Meyerding considered the case clinically malignant, but that the pathologists reported a benign osteochondroma. Excision was done, removing the contiguous bone of the upper 8 inches of the shaft of the tibia. The strip of bone which was left was in some parts very thin, but, even with this wide removal, the operator did not feel satisfied, for he predicted recurrence. This became evident in a few months; the recurrent tumor was aspirated on one occasion, and a jelly-like material removed. The patient refused to consent to amputation until 2 years and 9 months later, when pain became intolerable. Amputation was then done by Dr. Homer Hill of Austin. Dr. Hill sent the history of the case and a large part of the tumor to the pathological laboratory of the University of Texas. Unfortunately no portion of attached tibial shaft was left on the tumor and its origin from bone cannot be studied.

Pathological examination. The specimen as received is covered on one side by a fibrous capsule to which fat is closely adherent. From this a few delicate strands of dense fibrous tissue penetrate the tumor. The opposite surface of the specimen (where it has been cut free from its bony attachment) is very irregular, on account of the fragmentation of the soft milky gelatinous material composing the mass. Small cavities are present throughout, partly caused by mucoid degeneration, partly by the fragmentation of the solid tissues mentioned. The texture of the tumor as a whole is firm, but not hard like normal cartilage. A few areas of old hæmorrhage are present, and the pseudocapsule is discolored by hæmatogenous pigment.

Microscopically, sections show many areas of hyaline cartilage, with some patchy calcification. The intercellular substance in these areas is less dense than in adult hyaline cartilage, but the lacunæ are well formed and the cells quiet. Between such areas are masses of cartilage of the embryonal type, with more tenuous chondromucinous stroma in which the cells are stellate. Small cavities are scattered throughout the sections, some partly filled with mucous connective tissue. All of the microscopic features in such areas are those of benign myxochondroma. An occasional blood channel shut off from tumor cells by a thin layer of endothelium only, leads one to suspect a malignant tendency, but no tumor cells penetrate this endothelial lining. Between the definitely benign areas are groups of cells without intervening intercellular substance. These cells are irregular in shape, and rather close together, and present more mitoses than the cells in the myxochondromatous areas. No definitely heterotypic mitoses are present, but a slight irregularity in the size of the nuclei and the occasional presence of two nuclei in one cell still further suggest malignant transformation. Such areas of undifferentiated cells are few and far between in the benign structure and may be found only after careful search.

This case clinically and histologically, lies in the borderline group. Following a long slowly progressive course it has recurred after

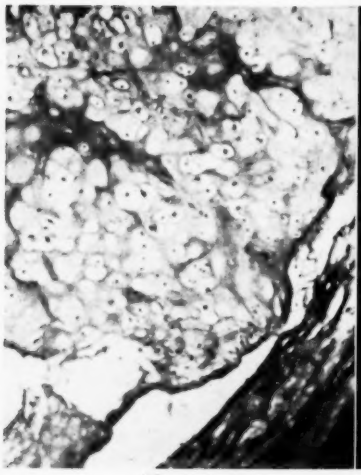

Fig. 13*A*.

Fig. 12.

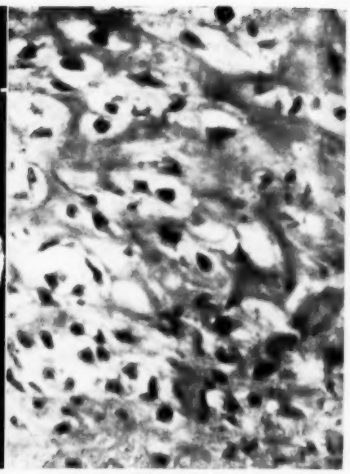

Fig. 13*B*.

Fig. 12. Case 6. Showing friable interior of a "borderline" chondroma of tibia.

Fig. 13. Case 6. *A*, Well formed cartilage forming the bulk of the tumor of the tibia. *B*, Area of cells round which little intervening intercellular substance has been formed. Such areas may explain the recurrence in this case, but they are not definitely malignant, as atypical mitosis is not present.

a fairly complete local extirpation. Even now it lacks the rapid cell growth, the irregularity in cell division, the total lack of cellular differentiation, the widely infiltrative tendencies and the quick spread by the blood stream characteristic of malignant osteogenetic tumors. Even the traumatism of incomplete removal has not stimulated it to very virulent growth. Metastases are not to be expected.

CASE 7. Central chondrosarcoma. S. P. 75. Female, white, age 54 years. Fifteen months ago the patient fell on the street striking her shoulder against the curb. The shoulder became swollen and discolored, but there was no great pain. Some pain and discomfort have, however, been constantly present since this injury. Five months later the plain became worse, the swelling increased, and the movements of the shoulder joint became restricted. When, more than a year after the injury, the patient came under Dr. Thompson's care there was marked swelling of the upper end of the humerus and the shoulder region and great limitation of movement of the arm. An indefinite area of rarefaction in the humeral head and upper part of the shaft was revealed by X-ray. An exploration was made by Dr. Thompson, and the upper end of the humerus and the entire joint capsule found to be the seat of a soft cartilaginous, infiltrating tumor. Formal excision was done as the patient had refused to consent to amputation. The marrow cavity below the line of section first made showed growth, and a further effort was made to eradicate completely the growth in this region. After the operation further attempt was made to get consent for shoulder girdle amputation, but it was not until 4 or 5 months later, when recurrence was manifest, that the patient accepted this as a last resort. The interscapulo-thoracic operation was performed elsewhere, so that study of the recurrence was impossible. The patient died within a year of the first operation from metastases in the lungs.

Pathological examination. The tumor is of soft cartilaginous tissue, much more firm in consistency than the cases previously discussed. It cuts with the brittle resistance of cartilage, but is less hard; it was pink in the fresh specimen, not milky. It forms a subperiosteal tumor 1.5 centimeters thick in the region of the greater tuberosity of the humerus and down the shaft contiguous to this, but in addition it infiltrates between the bone lamellæ of the interior of the head of the bone, and in fungoid strands down the marrow cavity. It has infiltrated the capsule of the joint which forms a thick tumor of the same texture. The articular cartilage of the humeral head is not affected by the growth. Microscopically, the tissue in the primary growth in the humerus and in the secondary extension to the capsule are identical. Both show large areas of hyaline cartilage with fairly well formed lacunæ, containing round or stellate acidophile cells. Some of the areas show degenerative changes; but there is no myxomatous element. In striking contrast to these benign areas, are others, especially marked in the peripheral regions of the tumor, where the cells embedded in hyaline matrix are more closely packed, hyperchromatic, and present evidence of malignancy. This is shown by the

Fig. 14. Case 7. Showing the infiltration of the upper end of the humerus by a typical chondrosarcoma. The extension down the marrow cavity is well shown. The capsule lying above the humerus, is converted into tumor tissue. The cartilage covering the head of the bone is not affected.

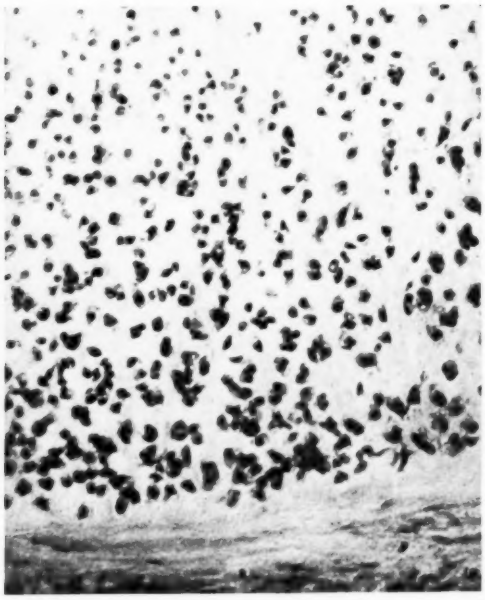

Fig. 15. Case 7. Rapid atypical cell proliferation on the surface of a highly malignant chondrosarcoma of humerus. Some of the cells may be seen in mitosis.

presence of nuclei of very varying size, and by the presence of cells containing a single very large nucleus, or multiple nuclei—three or even four in one cell body. These cells are of the type of the true tumor giant cell, and when they are found, are proof positive of malignancy. They bear no resemblance to the "foreign body" giant cell. The atypical cell division which is responsible for the production of these giant cells has led also to the formation of abnormally small cells with nuclei which are but half or a third of the size of the normal nucleus. No tumor lined blood spaces were seen. The histological picture harmonizes with the clinical evidence of rapidly-growing, infiltrating, metastasizing tumor.

Case 8. Peripheral chondrosarcoma S. P. 1339. Female, white, age 15 years. The patient had been aware of a swelling over the crest of the left ilium for the past 6 months. She felt no pain until 2 months ago, when pain in the lower part of the back and in the left iliac fossa became noticeable. Recently pain had been severe, aching in character, and constantly present. The patient was able to walk, but her left leg tired easily. She had been told that the hip was tuberculous, but jarring or moving the joint did not produce increased pain. Lately she had become anæmic and had lost some weight, but this was attributable to her constant pain. Examination showed swelling over the left iliac crest; the superficial tissues were not inflamed. X-ray of both hip and pelvis was entirely negative.

Operation was performed by Dr. J. E. Thompson. A soft pinkish cartilaginous growth was present over the posterior third of the crest of the ilium, spreading over the inner and outer surfaces of the ilium in a saddle-like manner, lifting periosteum with it. The tumor was easily removed by curette from the underlying bone, leaving this fairly smooth but more hæmorrhagic than normal. There were no deep extensions into the ilium, but peripherally the tumor showed no encapsulation. It spread in finger-like processes between the muscles attached to the crest of the ilium. Bleeding was profuse from the tumor tissue. Thorough eradication would have been impossible, since even the interiliofemoral operation could not have removed the whole of the muscular extension. Curettage was made as thorough as possible and the wound closed without drainage.

Convalescence was satisfactory. The patient was started at once on injections of Coley's fluid, and these were continued by her family physician to the limit of tolerance. Fungating recurrence made its appearance in a few weeks and death followed within 6 months. There were apparently no lung metastases; death was caused by local recurrence, ulceration, and cachexia.

Pathological examination. Nothing further need be said regarding the gross appearance of the tumor. Microscopically, it shows areas in which the cartilaginous matrix is well formed, and the cells placed in lacunæ. But even in these less cellular areas heterotypic mitoses have resulted in the formation of cells of varying size with abnormally large or abnormally

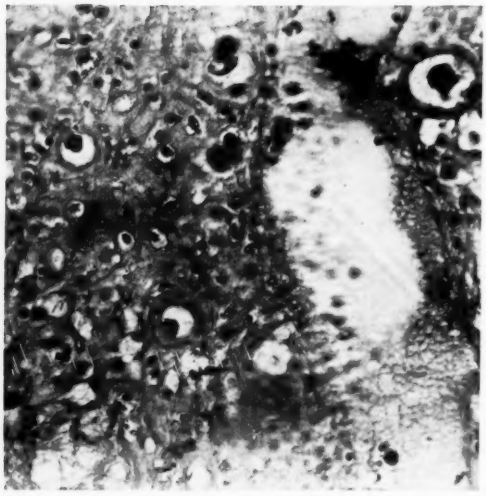

Fig. 16. Case. 8. Showing the great variation in size of the nuclei in a highly malignant chondrosarcoma of ilium. The cartilaginous matrix is well developed throughout this tumor.

small nuclei. Surrounding such cartilaginous zones are areas of rapidly proliferating cells. In these cells the nuclei are intensely hyperchromatic, mitoses frequent and atypical, resulting in the formation of nuclei bizarre in size, shape, and number. Some of these cells lie in lacunæ, some in formless chondromucin; many are growing too rapidly to have collected about them any intercellular substance. From the relations of these cells to those with cartilaginous matrix, it is demonstrable that the latter are but late developments from these highly malignant growing cells; for the resting cells of the inactive areas bear the evidences of preceding atypical malignant division in the irregularity in size, shape, and number previously noted.

This tumor like the preceding case presents clinically and grossly the appearance of rapidly growing, widely infiltrating, malignant disease and the histological picture confirms the clinical evidence.

DISCUSSION

Given a rarefying central or periosteal lesion in bone, one of the possibilities is a cartilaginous tumor. In certain situations, one may be reasonably sure before the exposure of the tumor that one has to deal with a chondroma, but in many instances the cartilaginous nature of the growth will be first revealed by the exploring knife. It becomes at once incumbent upon the surgeon to do all that is needful and to do no more. In lesions of other organs than bone, his experience is greater and his faculties trained. Of bone tumors, he will see comparatively few, even in the course of a long and active surgical career. The cases in this group selected for presentation range in orderly sequence from the innocent to the gravely malignant. Careful analysis should throw some light on the characteristics by which these tendencies may be recognized.

1. Rate of growth. Only under exceptional circumstances will this be of much clinical value. No cartilaginous tumor which has taken many years to grow has been malignant throughout the whole of its course. So far as is known, however, malignant transformation of a previously benign tumor may occur at any time, and this feature therefore loses diagnostic significance. A tumor which increases in size very slowly and steadily, or one which, after attaining a certain size, remains stationary, is at the worst, only mildly malignant or "borderline."

2. Encapsulation. The thick fibrous tissue capsule that plays so important a rôle in the shelling out of benign tumors of soft tissues is the first rallying point of the harrassed surgical pathologist. So much dependence has been put upon this, that many are a accustomed to look upon it as a product of the tumor itself. It is necessary to abandon this erroneous conception. It is now generally accepted that the capsule which surrounds a slowly growing neoplasm is a product of the environment, a wall of defense against the slowly increasing pressure of a foreign body. It becomes evident then that fibrous tissue in the environment is necessary to the formation of a capsule. In the case of a benign bone tumor, which arises or penetrates peripherally, the periosteum together with the surrounding fibrous tissue will aid in forming a capsule. In the interior of the bone, however, and at the bony origin of peripherally located tumors, no fibrous tissue capsule forms to wall off the tumor. The writer believes that this absence of capsule is due to the fact that bone is not in the habit of producing fibrous tissue around foreign bodies. The normal response of bone to slow irritation is the production of foreign

body giant cells and young granulations which later are destined to be replaced by osseous tissue. If given a chance, it will frequently produce such response around slowly growing tumors. Encapsulation is present between the soft tissues and a benign bone tumor, but is not present between the bone from which the tumor arises and the tumor. Whether the explanation suggested is correct or not, the *fact* is capable of demonstration. If the surgeon finds a definite external capsule, easily separable from the surrounding soft parts, enclosing a cartilage tumor, he may safely conclude that his tumor is relatively benign, even though he does not find the inner portion of growth sharply delimited. Of necessity this will aid only in neoplasms which are external to bone. Within the bone, whether this means within the marrow cavity or the external lamellæ, whether the tumor be benign or not, the surgeon cannot distinguish with the naked eye the intra-osseous limits of growth. Having no capsule to guide him, he must take some apparently healthy bone lest he leave some that is infiltrated.

3. *Vascularity.* The vascularity of the tissue of the tumor proper, not of the surrounding bone, is an aid in diagnosis. If the cartilaginous material is white, and does not bleed freely, it is probably not sarcomatous. The value of this feature is lessened by the difficulty of differentiating between bleeding from the tumor and that from the surrounding structures. This is illustrated in Case 4, in which the myxochondromatous tissue in the interior of the femur was almost bloodless, but the fibrosed bone of the shaft gave rise to sharp hæmorrhage. In the malignant cases the whole structure of the tumor was colored by numerous small vessels.

4. *Texture.* The dense hyaline tumor, resembling articular cartilage, is easily recognized as benign, but few chondromata resemble thus closely the normal structure. Mucoid degeneration with cyst formation, and true myxoma, do not of themselves indicate malignancy. Many benign chondromata are of the consistency of firm gelatin, or such tissue may form a wall to a cavity filled with viscid or even fluid contents, having the appearance and feel of mucous connective tissue. Whether this is the result of mucoid degenerative changes or of the presence of true mucous connective tissue can be determined by the microscope only. The evidence indicates that this is of no consequence to the operator since either or both conditions may be found in a benign tumor. Conversely, if a tumor infiltrates the surrounding tissues and presents other evidence of malignancy, the fact that the cartilage forming it is of firm consistency, must not be taken as proof of innocent growth.

5. *Histological findings.* Microscopic proof of malignancy in this series of cartilaginous tumors has been furnished only by the demonstration of atypical mitoses or the products of such mitoses. Histologically, myxomatous tissue has long been considered suspicious, but there is no proof at the present time that the production of mucous stroma without nuclear signs of malignancy on the part of the cells lying in that stroma, is an indication of malignancy. In this series true myxomatous tissue is demonstrable in tumors clinically proved to be benign. Frequently careful search through different parts of a tumor will reveal widely different histological features. When a tumor of apparently pure myxomatous tissue produces metastasis, such metastasis is attributable to other elements in the tumor than fully differentiated mucous connective tissue cells. Similarly groups of undifferentiated cells without atypical mitoses have been considered suspicious, but such cells have been found in a tumor with a long relatively benign clinical course (Case 6) and cannot be assumed as proof of malignancy. They indicate at most a tendency toward a malignant change and in the absence of other evidence of atypical growth such tumors should be reported as "locally malignant" or "borderline." Because pathologists differ, all reports of cases should include accurate histological descriptions. Unbiased judgment might then be based on clinical, gross, and microscopic evidence, and pathological nomenclature standardized. The apparently divergent results of treatment might then be checked with some hope of formulating definite rules of procedure.

NOTE.—No bibliography is appended as this paper is intended rather as a record of personal observations than as a critique of the work of others.

FRACTURES OF THE FOOT

By LEO DRETZKA, M.D., F.A.C.S., Detroit, Michigan

IN assigning to man of all the mammals, a permanently upright posture, nature devised for him a remarkable mechanism in the foot. It is continuously subjected in walking to jolts and jars, it is required to support on a relatively small surface the entire body weight, and it is exposed to a variety of traumatisms, ranging from a stubbing of the toe to the impact of a heavy weight.

The arch form of the foot affords a stable support and the maximum of mobility and leverage in walking. The keystone of the entire anatomy of the leg is the foot arch, as a sound leg obviously is of no use when the foot is disabled. In primitive man, and in the case of the laborer of today, a disabled foot means an absolutely helpless person.

In my series of 2,440 injuries are listed 332 fractures and of this number, 72 are fractures of the feet, demonstrating the resistance of the foot structure to injury. The commonest cause of foot fractures is the dropping of a heavy weight directly on the foot. Falls from considerable height produce a lesser number. Fractures of the bones of the tarsus are seldom caused except by very serious falls in which the victim alights in an upright position on a relatively hard surface. If the bones of the anterior pillar are broken, it is usually by direct violence—very heavy pressure from above. The bones of the posterior pillar are broken both by falls and blows or pressure.

Knowledge of the manner in which the injury was received is of diagnostic value, but the one absolute rule in examination of foot injuries is to X-ray the foot from every possible angle. Many cases of sprained ankle have been cases of fracture of the astragalus.

ASTRAGALUS

In falls, the astragalus is in most instances broken at its weakest part—the neck. The fracture may be simple or comminuted. If the foot is dorsiflexed, the anterior articular edge of the tibia may, in the manner of a wedge, split it across. The disability in fractures of the astragalus is extreme and the victim cannot walk. There is swelling, pain, crepitus, and distortion of the ankle joint.

Fig. 1. Lateral projection of the foot shows an extensive, oblique fracture extending through the postero-inferior portion of the os calcis across the joint surface. There is a second fine line extending across the superior posterior surface. The upper fragment is being pulled by the tendo achillis, so that there is a fairly wide separation—about three-eighths inches—at the postero-inferior junction. The astragalocalcaneal articulation is not disturbed.

Fig. 2. Lateral view of the foot shows an extensive comminuted fracture of the posterior third of the os calcis extending into the astragalocalcaneal joint, with a marked separation—about 1 inch—of the upper fragment of the os calcis evidently pulled upward by a spasm of the tendon of Achilles. There is a fairly marked disturbance in the relationship which usually exists between the astragalus and the calcaneus.

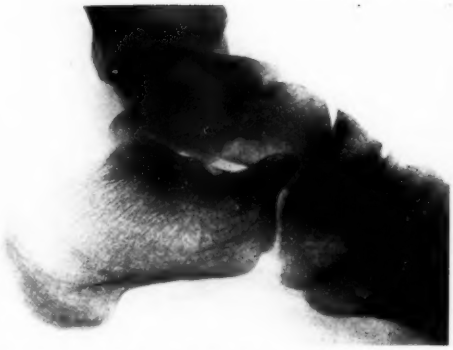

Fig. 3. Lateral view of the foot shows several linear fractures extending obliquely through the middle third of the astragalus with fragmentation of the external surface of the astragalus with some rotation upward of the external fragment.

The treatment is reduction under the fluoroscope when the fracture is not severe. If the fragments are badly displaced, excision is necessary. Removal of all or part of the bone gives fairly good functional results. The foot is then immobilized at right angles with the leg.

OS CALCIS

The heel bone is fractured by a fall on the sole of the foot as well as by a powerful contraction of the gastrocnemius muscle and tension of the tendo achillis. The variety of fracture resulting is a large posterior heel piece or a general crushing of the central or anterior two-thirds.

The symptoms are pain, swelling, change in the level of the malleoli and crepitus. Ecchymosis at the tendo achillis is typical. The foot should be placed at rest and ice packs applied until the swelling subsides. Open operation may be necessary, suturing or pinning the fragments together. In the majority of cases, reduction may be brought about by placing the heel on a padded wedge and pounding it in shape. Simple tenotomy may be the only treatment necessary in some of these cases.

The period of disability may extend to 6 months and in serious cases impaired pronation and supination of the foot may persist for a longer period.

Fig. 4. An anteroposterior view of the right foot shows a comminuted fracture of the distal third of the distal phalanx of the great toe. There is an oblique fracture of the inner side of the proximal end of the proximal phalanx of the great toe. There is a comminuted crushing type fracture of the distal end of the metatarsal bone of the great toe with a linear fracture line extending the entire long axis of the same metatarsal. There is also a small chip fractured from the external sesamoid. There is also a T-shaped fracture of the lower third of the second metatarsal bone, no displacement. The proximal phalanx also shows a small localized area of bone rarefaction at its distal extremity.

METATARSAL BONES

This group is invariably injured by direct violence. The first, although the strongest, is most frequently broken because it carries so large a proportion of the body weight and receives much violence in falls associated with eversion of the foot. The fifth comes next in frequency because of its exposed position. Fracture of the third metatarsal is apt to destroy the arch of the foot.

After reduction of the fractured bones, the foot should be placed in a posterior molded plaster splint with particular attention to the maintenance of the foot arch. Early massage and baking is important. This includes diathermy. Compound infected cases require drainage and much attention to minimize necrosis.

PHALANGES

Fractures of the toes are also due to direct violence and are therefore often compound and infected. The diagnosis is simple compared with that of the other bones of the foot. The treatment is reduction by manipulation and traction and then proper immobilization in a plaster mold.

DIVERTICULUM OF THE BLADDER CAUSING DYSTOCIA AT LABOR

Report of a Case

By WILLIAM L. WOLFSON, M.D., F.A.C.S., Brooklyn

BECAUSE diverticulum of the bladder occurs so rarely in the female,[1] and particularly since in the case described it resulted in an interference with the normal progress of labor, the following case is deemed worthy of being reported.

M. A., an American housewife, white, age 28, came to my office, complaining of frequency and ardor of urination since the delivery of her only child on May 1, 1923. The history showed that there had been nothing unusual observed during the course of the pregnancy. Antepartum studies by her family physician, including frequent examinations of the urine, revealed no abnormal findings. The labor had been active, with severe pains, and after 17 hours with the cervix fully dilated for several hours and no advance of the fetal head, her physician terminated the labor by the application of forceps. He declared that he experienced an obstruction in his traction, which obstruction was suddenly overcome with a jerk. The child was then delivered quite readily. The soft parts of the mother's parturient canal suffered extensive laceration, but her condition after delivery was such that it was deemed inadvisable to perform repair. The child bore evidence of the trauma of the procedure.

At first the mother's state was precarious, and although she was later improved sufficiently to permit her removal to her home on the nineteenth day postpartum, the puerperium was stormy. The patient was anæmic, weak, and prostrated; the lochia was foul; and she developed a phlebitis, first in one lower extremity and then in the other. For 3½ months her temperature ranged from 101 in the morning to 104 in the afternoon. Within several days after delivery the urine was found to be cloudy, and had a fetid odor. A slight burning pain was present on urination, and this gradually increased, as did also the frequency. Finally she was voiding almost every hour during the day and four or five times during the night. Examination of the urine shortly after these urinary symptoms first appeared showed the presence of large amounts of pus.

The patient's history previous to the delivery had been relatively negative. She had had whooping cough in childhood and typhoid fever at the age of eight. Her menses had always been normal. She had had an appendectomy performed in 1919 and believes that an oophorectomy was also done at that time.

Physical examination. The patient was a young female, anæmic and evidently suffering from a chronic septic condition. The lower eyelids were bluish and very puffy. The skin was transparent and the veins very noticeable.

The abdomen was thin and scaphoid. A median suprapubic scar, 4 inches in length, was present.

[1] Only two cases were treated surgically at the Mayo Clinic from 1894–1923. E. S. Judd. Surg. Gynec. & Obst., 1924, xxxviii, 16.

Fig. 1. A cystogram showing the position of the bladder.

Fig. 2. Showing ureteral catheter curled within the diverticulum.

Fig. 4. View of bladder and diverticulum. Ureteral catheters in place. Catheter into diverticulum.

There was no tenderness in the lower part of the abdomen, nor any rigidity. No masses or organs were felt in the abdomen.

Vaginal examination. There was a bilateral laceration of the pelvic floor with almost no levator support. The cervix was practically absent, the os being almost flush with the vaginal vault, and scars extended from it across the lateral fornices. In the left lateral fornix resistance was felt, suggesting an exudate; but it could not be definitely defined nor mapped out. The urethral orifice was excoriated, patulous and relaxed. The anterior vaginal wall was in fair condition. Blood pressure was 106-80. Temperature 99.2.

Otherwise physical examination revealed no other abnormality.

Urinalysis showed specific gravity, 1018; reaction, acid; color, amber, though slightly turbid; albumin, moderate amount; sugar, negative; acetone, negative. Much pus, many squamous epithelial cells, but no casts and no erythrocytes were found.

Fig 3. Diverticulum filled with sodium bromide solution.

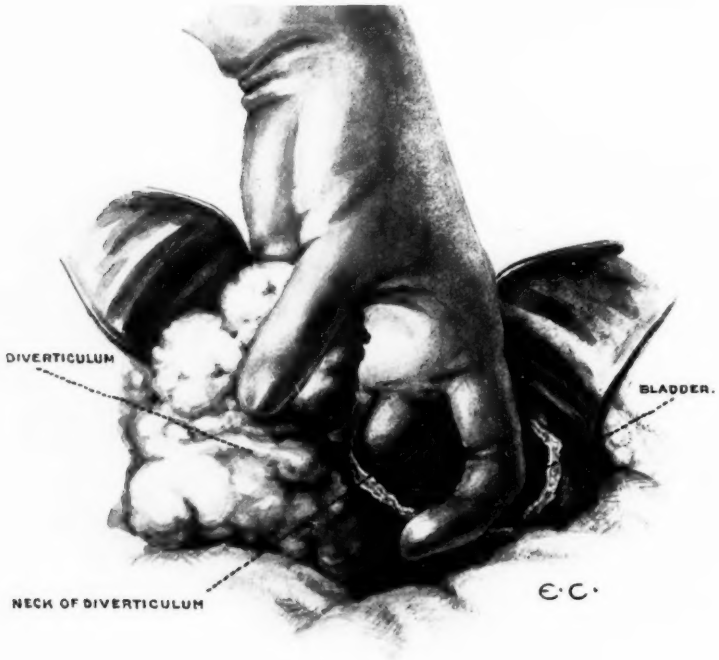

Fig 5. Middle finger in bladder jammed into diverticulum. The finger is also used as a tractor.

Cystoscopic examination revealed a moderate general cystitis and trigonitis. The ureteral orifices were normal. Catheterized urines from both kidneys were clear, and practically negative chemically and microscopically. Above the interureteric fold, about 2 centimeters to the left of the median line was an opening, 0.5 centimeter in diameter, from which thick wormlike pus was being extruded. The diagnosis was made of diverticulum of the bladder. Complete cystoscopic and roentgenographic studies were made by Dr. Ravich, and to him I am indebted for his valuable assistance and excellent cystograms (Figs. 1, 2, 3).

Operation (December 14, 1923). Preliminary to operation the bladder was thoroughly irrigated and filled with sterile water. An operating cystoscope was introduced and both ureteral orifices were catheterized with No. 6 F catheters, and a larger catheter, No. 9 F, was introduced into the diverticulum. From this sac a large quantity of foul-smelling brownish pus was evacuated by aspiration and the sac irrigated until the return flow was clear. Its capacity was found to be 75 cubic centimeters. All three catheters were left *in situ*, plugged, and the ends strapped to the patient's thigh.

Ether anæsthesia was then administered, and a median incision was made extending from the symphysis pubis upwards for 5 inches. The old scar, 4 inches in length, also situated in the midline, was excised. The fascia was split, and the recti muscles separated. The bladder was thus exposed extraperitoneally. It was impossible to separate the peritoneum from the bladder posteriorly, because of the dense postoperative adhesions and reactive exudate which were present about the diverticulum and the broad ligament on the left side. The peritoneum was accordingly opened up and the intestines well walled off with pads. The bladder was now fixed with two sutures for traction, an opening made between them, and the filling solution evacuated. The interior of the bladder with the catheters *in situ* was then clearly observed (Fig. 4). The large catheter in the diverticulum was withdrawn, and the operator's left little finger jammed through this opening into the diverticulum. This finger was then removed and the middle finger of the same hand introduced into the opening of the sac. Using this finger as a tractor (method of Judd of Mayo Clinic), the sac was raised upward and backward (Fig. 5). It was deeply placed beneath the bladder. Inflammatory reaction had sealed it to the left broad ligament, which was above it. Below the sac was

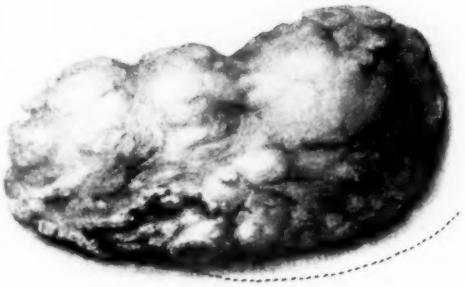

Fig. 6. Diverticulum of bladder; capacity 75 cubic centimeters (2½ ounces) M. A., Female, age 28.

Fig. 7. Diverticulum of bladder showing interior view. Origin immediately above trigone.

fixed in the pelvis, and to the inner part it hugged the left lateral wall of the uterus. The outline of this sac was roughly ovoid, and its upper surface was covered by the expanded left broad ligament, the vessels of which were extremely large and tortuous. Its position might be likened to that of a cervical fibroid growing intraligamentously.

In dissecting out the diverticular sac it was necessary to sacrifice the entire left broad ligament from the side of the uterus to the lateral wall of the pelvis. The left ureter, with its indwelling catheter, was seen in its course and carefully avoided. The sac was dissected free, although it was quite adherent at its junction to the bladder. Since it could not be tied off, it was cut away. Closure of the opening into the bladder was performed with a double row of continuous sutures. Because of the depth of the site of operation this was accomplished with great difficulty. The upper, or incisional, opening into the bladder was now closed with two rows of continuous catgut sutures. Raw surfaces in the pelvis were covered over with peritoneum wherever possible. The uterus which had been pushed to the right by the diverticulum was suspended by the Olshausen method. The right tube was found to be somewhat hydrocystic and held down by a few adhesions. The right ovary was atrophic. The appendix was absent, having been removed at a previous operation. The left tube and ovary were also absent. Drainage was accomplished by placing one cigarette drain into the peritoneal cavity behind the uterus and another into the space of Retzius. A self-retaining catheter was inserted through the urethra into the bladder.

Pathological report. The specimen is a diverticulum of the urinary bladder (Figs. 6 and 7). It shows a marked necrosis of the mucosa and marked œdema and atrophy of the muscular coats. Here and there are collections of inflammatory cells, principally of the small round cell type. In one area there is a marked replacement of the muscular tissue by a highly cellular tissue, the cells of which are spindle and oat shaped. Diagnosis: subacute and chronic inflammation of diverticulum of the bladder. Bacteriological examination of pus obtained from the diverticulum showed a mixed infection, there being present staphylococci, streptococci and gram positive aerobic bacilli.

Postoperative course. The postoperative notes record that 7 days after operation the self-retaining catheter had to be removed because of clogging. On the ninth day postoperatively urine began leaking through the abdominal wound. Moderate infection of the wound followed, but the entire wound was closed and completely healed 4 weeks after the operation. Six weeks after operation the patient reported that she had excellent control of her bladder and was voiding 10 ounces at a time. Urinalysis at this time showed the urine to be free from pus and normal in all other respects.

The obstetrician encounters many causes of dystocia. Search of the literature reveals no record of another instance in which a diverticulum of the bladder has interfered with the descent of the fetus. In this case the diverticulum, about 2.5 by 4 inches in size, situated beneath the bladder, and at the left broad ligament, and extending from the lateral border of the uterus to the left pelvic wall, by its situation and size caused an abnormal labor. It prevented the fetal head from coming through the pelvic brim and necessitated a forceps extraction. And just as the diverticulum influenced the course of the labor, so the labor influenced the course of the diverticulum. Previously the latter had given no symptoms. In the course of the labor and delivery it was traumatized, and becoming infected, pyuria, frequency, and ardor resulted, and the systemic manifestations of chronic septic infection became evident.

EMBRYONIC RESTS OF THE URINARY BLADDER

By FLETCHER H. COLBY, M.D., Boston
From the Urological Clinic of the Peter Bent Brigham Hospital

CONGENITAL malformations of the genito-urinary tract may be present in any degree, minor or marked. Thus there are found such slight deviations from the normal as mild hypospadias; and analogous conditions exist in increasing severity up to the gross abnormality of the exstrophied bladder, in which the whole of the lower urinary tract lies open. The minor degrees of abnormal development usually affect the external genitalia, and are common and easily recognized. Minor congenital faults of the bladder, however, are less common and more difficult of accurate diagnosis. The following account describes an unusual lesion of the urinary bladder with the report of a case in which it is most probable that the fault arose from a defect in embryological development.

It is hoped that similar cases will be added to the literature since it seems probable that this condition, while rare, is occasionally encountered. A familiarity with the lesion will aid in its diagnosis.

(Surg. No. 19476). A widow of 50 was admitted to the hospital August 17, 1923, complaining of frequent and painful urination. Her family history and marital history were unimportant, and her past history entirely negative. The first symptoms referable to her present condition began 5 years earlier, and consisted of sharp pain in the suprapubic region at about weekly intervals. Urination was painful and frequent, and she had passed small amounts of gravel many times. These symptoms persisted through the years, increasing in severity and frequency in the last year. Upon one occasion, shortly before entering the hospital, she passed a good sized stone with urine colored with blood.

Physical examination showed a woman in good general health with no noteworthy physical abnormalities. The urine contained an occasional red cell and pus cell.

Cystoscopy demonstrated an irregular area on the right edge of the trigone raised about 2 millimeters above the bladder floor. This area was roughly circular and of a deep reddish color. In spots, where the tissues extended highest above the base, there were definite calcium deposits appearing as white granular débris. The rest of the bladder was normal. The right ureteral orifice was not seen. The appearance as a whole was strongly suggestive of a neoplasm on which, by reason of necrosis, lime salts had been deposited. One fact inconsistent with this diagnosis was that it had been known to exist for at least 5 years without the appearance of hæmaturia or other evidence of progressive disability. No induration of the bladder floor could be felt by vaginal palpation.

Operation. Under gas and oxygen anæsthesia the bladder was opened by a mid-line suprapubic incision. The irregular raised area on the edge of the trigone was excised and the edges of the bladder mucosa approximated. The tumor seemed to involve the muscular tissue, and some care was necessary in dissecting it free from the vagina. Postoperative convalescence was uneventful, the patient being discharged well, 19 days after operation.

Pathological examination. Grossly the specimen consists of an irregular plaque of tissue about 1.5 centimeters square and 0.5 centimeter thick. The bladder mucosa is eroded. The side toward the mucosa is shiny, white, and thickened. On microscopic examination the tissue consists of smooth muscle and fibrous tissue resembling bladder wall and containing gland-like structures lined with columnar epithelium, chiefly of goblet cells. These mucus secreting cells bear some esemblance to rectal mucosa. A round-cell infiltration is present. There are numerous large blood vessels.

Diagnosis. Bladder wall with aberrant glands possibly of cloacal origin.

On examining microscopic sections of this small bladder tumor one is impressed with its similarity to the picture seen in cases of congenital exstrophy of the bladder. In the tissue from the tumor and in the mucous membrane of the exstrophied bladder are found large mucus secreting cells in gland formation resembling rectal mucous membrane. The histological structure of the mucous membrane in cases of exstrophy of the bladder has been described as being similar to that of the large intestine by numerous observers. Shattock (4) in 1894 described thickenings in the mucous membrane of the exstrophied bladder which, on microscopical examination, were ingrowths lined with mucus secreting epithelium. The muscular coat was not involved and the condition was regarded as non-malignant. He described the tissue as closely

Fig. 1. Normal bladder, low power.

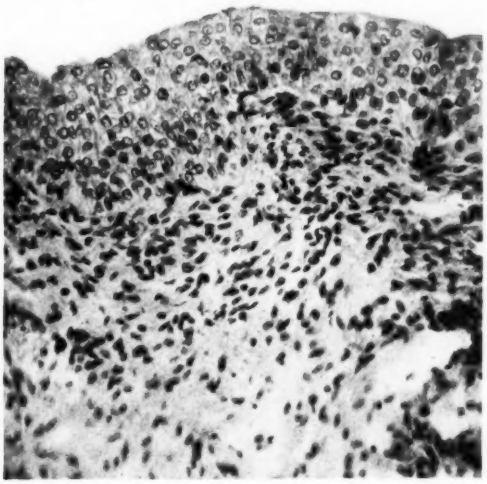

Fig. 2. Normal bladder, high power.

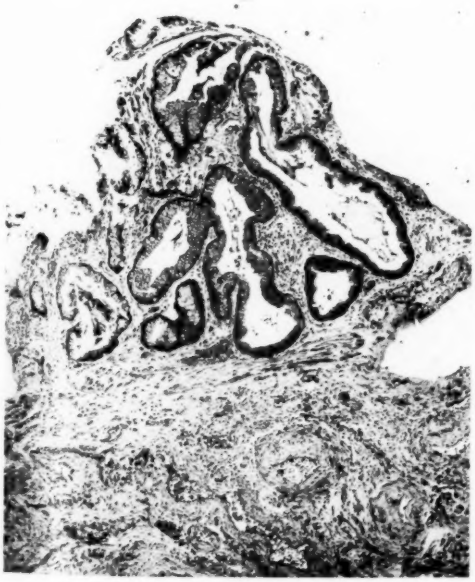

Fig. 3. Lesion found in Case 1, low power. Note the large mucus secreting cells in gland formation.

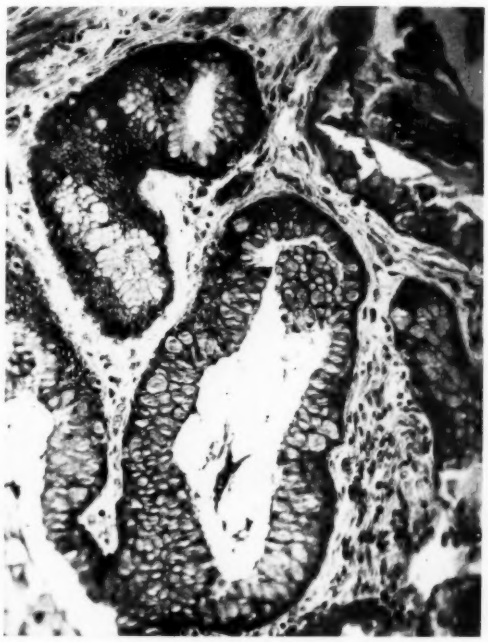

Fig. 4. High power field of Figure 3, showing more detail of the mucus secreting cells in gland formation.

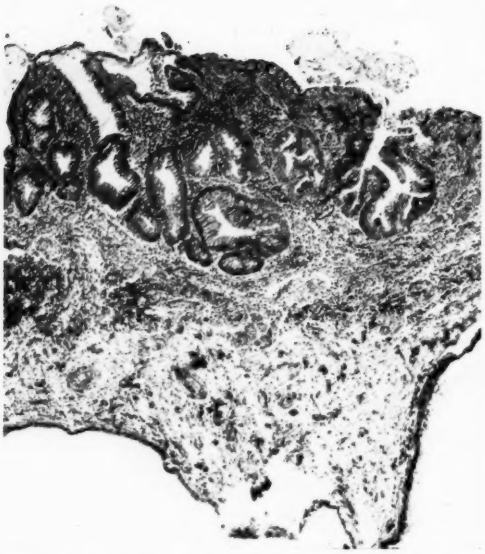

Fig. 5. Low power of a case of exstrophied bladder. Note the well marked similarity between this section and that shown in Figure 3, both showing the large mucus secreting cells in gland formation.

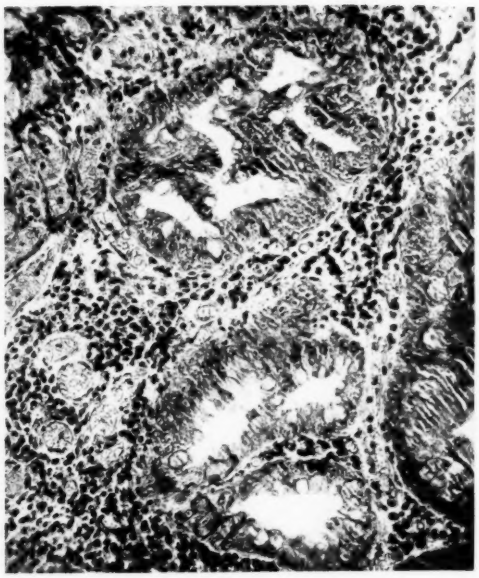

Fig. 6. Photomicrograph of a high power field of a portion of the exstrophied bladder shown in Figure 5. The muscus secreting cells in gland formation are similar to those shown in Figure 4.

resembling an adenoma arising in the intestinal mucosa. In cases of exstrophy of the bladder mentioned by Keith (3) reference is made to the similarity of the mucous membrane in exstrophy to that of the large intestine. Aschoff (1) describes the epithelium of the ectopic bladder as being of normal condition in the newborn, but with increasing years, by development of large mucous glands, it takes on a condition like that of the rectum.

Exstrophy of the bladder is a developmental defect resulting in imperfect closure of the anterior wall of the bladder. Its exact embryological origin is not entirely clear. Johnston (2), in one of the more recent studies of this subject, reached the conclusion that it is due to an excessive rupture of the urogenital part of the cloacal membrane at a site cephalad, instead of caudad, to the genital tubercle.

It is reasonable to suppose that the condition present in this case, in which the tissue was found to be composed of groups of mucus secreting cells like those normal to the rectum, had an origin similar to that of the glands that are found in the mucosa of the exstrophied bladder.

No description of this particular type of bladder lesion has been found recorded in the literature, although the condition has doubtless been observed by others.

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THE CYTOLOGICAL EXAMINATION OF THE URINE AS AN AID TO THE DIAGNOSIS OF TUMORS OF THE GENITO-URINARY TRACT

By F. J. PARMENTER, M.D., F.A.C.S., Buffalo, New York

FOR some time it has been the practice in the laboratory of the Buffalo General Hospital to supplement the usual laboratory procedures in all cases of suspected tumor of the genito-urinary tract with a careful search of the urine sediment for tumor cells. If we should reflect for a moment upon the nature of the tumors that are likely to arise in these organs such a procedure would seem an obvious necessity. Tumors of the urethra, bladder, ureter, and pelvis originate mostly in the mucous membrane and thus appear first in the lumen of the tract where they are continuously washed by the urine, with the result that some of the cells may become loosened, carried along, and passed out. Even in tumors of the prostate, with the exception of the benign forms, the surface of the bladder or urethra may rapidly become involved, and, likely as these tumors are to break down, some of the elements of the neoplasm will hardly escape being washed out with the stream of the urine. Malignant tumors of the kidney, especially the hypernephroma, are very prone to extend into the pelvis, break down, and thus give rise to the presence in the urine not only of isolated tumor cells but also of particles of tumor tissue. It would seem reasonable to expect the presence of tumor cells in the urine in hypernephroma as soon as hæmaturia has occurred, as that signalizes in most cases the appearance of the growth in the renal pelvis or its indirect relation with it through the tubules.

Nevertheless, the examination of the urine for tumor cells does not seem to be in vogue. Whether it is universally neglected or not, it is difficult to say; it is not at any rate a standard procedure, judging from the literature on this subject. A reason for this is perhaps to be found in the difficulty of distinguishing tumor elements in an isolated state from other tissue cells, especially epithelial elements when they have been acted upon for some time by a decomposed or even a normal urine within or without the body. Furthermore the tumor elements which are loosened up are very likely to be those that have undergone various degrees of degeneration or even necrosis, frequently with incrustation, so that when they appear in the sediment they are no longer recognizable as such. For this reason as well as for many others it is quite true that in a certain percentage of cases this procedure will yield no definite results. However, as in most laboratory procedures, especially in the quest of tumor cells in other body fluids, such as ascitic fluid, chest fluid, cerebrospinal fluid, the negative result will have little or no significance. The positive result only is of value and may sometimes spare the patient some extra painful manipulation and rarely be the only means of establishing the diagnosis of tumor in cases of doubtful cystoscopic results.

The methods employed in the laboratory to demonstrate tumor elements in the urine are simple. The main principle in the technique is to present a picture of the tumor elements as close to that seen in the tissue slide as possible, in other words a picture which is similar to that upon which the pathologist is in the habit of deciding the question of tumor. The method therefore is essentially a histological one.

When a specimen is received in the laboratory, it is immediately divided into parts, one part for the usual laboratory procedures and another part for histological purposes. To the latter an equal part of 20 per cent formalin is added and the whole centrifuged. The sediment may now be spread upon a number of slides, allowed to dry, covered with a very thin layer of collodion (by pouring rapidly over the slide a 5 per cent solution of collodion U.S.P. and allowing to dry) and stained. In order to facilitate the drying of the sediment, before it is spread it may be washed once or twice with strong alcohol provided no fat stain is required.

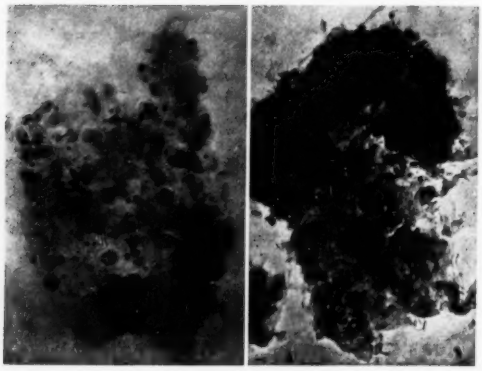

Fig 1 (left). Case 1. Sediment showing hypernephroma cells, isolated and in groups; among them leucocytes and erythrocytes.
Fig 2. Case 1. Clumped tumor cells.

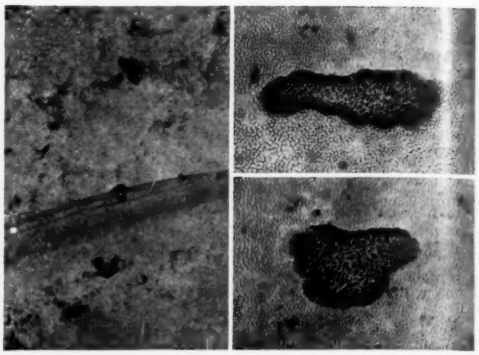

Fig 3 (left). Case 2. Fragments of villi of papillomatous tumor surrounded by blood cells, as seen in sediment at low power.
Figs. 4 and 5. Case 2. Higher magnification of parts of Figure 3.

Or, what is a still better method, the entire sediment is collected and imbedded in paraffin, cut on the microtome, deparaffinized in the usual way and stained.

The stain used is that which is most common in histological technique, namely, hæmatoxylin and eosin, supplemented as required by other stains or microchemical reactions.

The pictures presented by this method in cases of tumor are rarely unequivocal especially when the cells are isolated and the tumor composed of elements resembling in size those of normal transitional epithelium as in the benign or malignant papillomatous tumors peculiar to these organs. On the other hand, with these tumors there are often shed masses of epithelium in the urine, representing whole villi or parts of them which, under the microscope, are readily distinguished from the ordinary aggregations of normal bladder epithelium. The detachment of such villi in the upper part of the tract is also favored by manipulation with the catheter, as is shown by their frequent absence in the normally voided urine and their presence in the catheterized samples.

In epithelial tumors of the kidney the interpretation is not less difficult, but here, too, there is the possibility of encountering some of the elements united together in the form of an alveolus or tubule suggesting at once the presence of tumor. In hypernephroma, the most common malignant growth of the kidney, the cells themselves are often sufficiently characteristic, when a diagnosis may even be ventured on isolated elements. These characteristics are to be found in the clear, massive, vacuolated cytoplasm in which lipoids can be abundantly demonstrated.

In general, the presence of tumor may be assumed when there are unusually large cells differing greatly in appearance from the almost always present normal epithelium, containing irregular nuclei, among which are also found multinucleated cells, and especially when mitotic figures are not infrequent.

Needless to mention, the finding of tumor cells in the urine does not localize the tumor, except perhaps the finding of hypernephroma cells, but with the aid of the catheter alone this procedure will easily indicate the affected side.

Even in the lower part of the tract the presence of tumor may thus be detected before cystoscopy has been resorted to, which is a point to be borne in mind by the general practitioner especially in cases of hæmaturia.

The following two brief case reports are offered as illustrations of the value of routine cytological examination of the urine sediment.

Case 1. C. G., male, age 56 years, married, accountant, was suddenly seized December 23, 1911, with a sharp pain in the region of the left hip radiating to the perineum and inner side of the left thigh

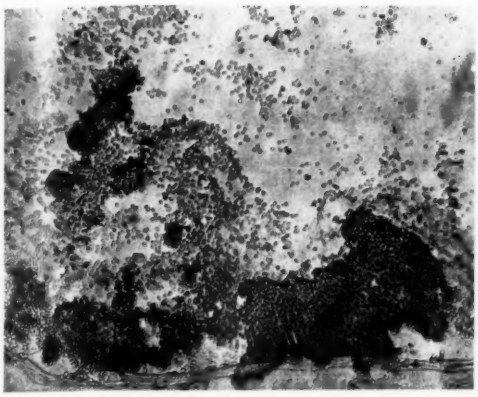

Fig. 6. Sediment obtained from the urine of a patient suffering with papillomatosis of kidney, mentioned in text.

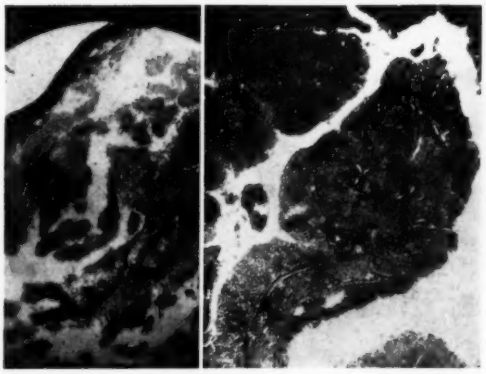

Fig. 7 (left). Same case as in Figure 6. Section from pelvis of kidney.
Fig. 8. Higher power of part of Figure 7.

and interfering with his walking. The pain was not confined to the genitals or kidney, and was not accompanied by urinary symptoms; it lasted 2 hours. Following this, the patient felt well. The pain never returned.

On December 31, 8 days later, he voided a port-wine-colored urine containing small, dark blood-clot without discomfort. Following this, the urine was clear to the patient's eye until January 10, 1922, when he again voided some bloody urine, after which the urine again cleared up rapidly. There is nothing in the previous history of the patient which has any bearing on the case.

Physical examination revealed among other things a moderately enlarged heart; blood pressure 190-110; abdomen, negative except for a distinctly palpable smooth but not tender lower pole of the right kidney; external genitals, rectal sphincter, prostate, and seminal vesicles, negative.

Blood count, differential, hæmoglobin, and blood chemistry were not remarkable.

The cystoscope passed easily, the bladder urine was clear, and the bladder normal. The left ureter was easily catheterized; the right offered a very slight resistance in its intramural portion. Function from the left side was active normal; from the right side, slow normal. Indigocarmine, intravenously injected, appeared in full strength from the left side in 2 minutes; from the right side in 4 minutes. X-ray examination with catheter *in situ* was negative as to calculi; both kidneys appeared large but regular in outline.

Examination of the urine from both kidneys and from the bladder was negative as to pus and micro-organisms. On cytological studies of the sediment, however, there were found among the numerous erythrocytes, white blood cells, and apparently normal epithelial cells, a considerable number of strikingly large epithelial cells of irregular shape and form, containing one or more (2 to 6) large irregularly shaped nuclei rich in chromatin, and showing mostly a massive, acidophilic, vacuolated cytoplasm. The latter on fresh specimens treated with Sudan III appeared loaded with lipoid material. Occasionally one of the cells was found to be in a state of mitotic division.

These cells were interpreted as tumor cells representing in all probability a hypernephroma, and their presence in the urine obtained from both ureters naturally pointed to a bilateral affection. However, a second catheterization with plugged

Fig. 9. Particle of tissue found in sediment of a case not mentioned in text. Here the diagnosis of malignant papilloma could readily be made.

catheters showed the tumor cells to be present in the urine obtained from the right side, while that obtained from the left side was entirely free from them.

At this examination hæmaturia reappeared. A rather unsuccessful pyelogram (on account of the hæmaturia) of the right kidney did not show the characteristic features of tumor.

At operation a hypernephroma was found occupying the upper part of the right kidney, which was removed.

In illustrating the value of the cytological examination of the urine in this case in which not only the presence but also the nature and consequently the location of the tumor was revealed by this method, it may be pointed out that tumor cells were demonstrable even at the first examination, notwithstanding the absence of gross hæmaturia.

CASE 2. J. A., male, age 28 years, Italian, woodfinisher, complained of pain in the upper abdomen radiating to both loins but worse on the left side. Family and past history are unimportant.

In August, 1923, the patient was seized with a sudden severe pain in the abdomen radiating to the loins and lower part of the chest and accompanied by nausea and vomiting. The pain seemed a little more on the right than on the left side, and was severe enough to require morphine hypodermically. Several subsequent attacks at various intervals were increasingly milder, and in one of them the pain seemed to have shifted to the left side. Following his latest attacks, his back would remain "sore" on the left side for several days. The attacks had no relation to food and there was nothing to indicate any gastro-intestinal disturbance.

Physical examination revealed nothing of importance.

Patient was easily cystoscoped. The bladder urine was clear, the bladder normal except for a slight œdema around the left internal orifice. Both ureters were easily catheterized. Function was rapid normal on both sides. Indigocarmine appeared in full strength from both sides. Capacity of each pelvis was 6 cubic centimeters. X-ray with catheters *in situ* was negative as to stone.

Cytological examination of the urine showed in all three samples (right and left ureter and bladder) few red blood corpuscles, fewer leucocytes, and many epithelial cells discrete and in groups arranged in the form of villi suggesting strongly a papillomatous growth. The villus-like cell groups seem a little more numerous in sample from the left side.

A second cystoscopy and ureteral catheterization with three sets of samples, collected at intervals of 5 minutes, yielded similar results. As in the first cystoscopy, plugged catheters were used.

The condition assumed to be responsible for this patient's illness is, as appears from the findings in the urine sediments, a bilateral papillomatosis of the upper part of the genito-urinary tract, probably the pelvis. Another example of this comparatively rare condition in unilateral form was recently diagnosed in the same manner and successfully operated upon on another service of the Buffalo General Hospital. That case will be reported elsewhere.

SUMMARY

1. The cytological examination of the urine sediment in cases of suspected tumor of the genito-urinary tract, especially according to the methods described in this paper, is a valuable aid to diagnosis and should be practiced as a routine procedure.

2. Its greatest value is for suspected tumors of the upper part of the tract, especially hypernephroma.

3. As in most laboratory examinations, only positive results are of value.

4. Negative results may signify, besides the absence of tumor, failure of communication of the tumor with the lumen of the tract, failure of breaking down of the tumor, inability on the part of the examiner to recognize the tumor element due to degenerative changes in the latter, or inability to distinguish them from normal epithelial cells.

5. It seems a good plan to have all urines in all cases of hæmaturia examined for tumor cells before proceeding with cystoscopic examination.

6. Two cases are offered in illustration of the value of the procedure.

In conclusion, the writer wishes to express his appreciation to Dr. Benjamin F. Roman for his valued assistance in the preparation of this paper.

UNDESCENDED TESTICLE

By S. GAYLORD SONNELAND, M.D., Cleveland, Ohio
Fellow in Surgery, Cleveland Clinic

THE term *undescended testis* is used to define a congenital anatomical defect which is characterized by a testis which has failed to progress distally from the point of its intra-abdominal origin, or one, the descent of which has been interrupted at some point within the normal pathway of migration to the scrotum.

On the other hand, the term *ectopic testis* refers to a congenital or traumatic anatomical anomaly which is characterized by the position of a testis which lies not only without the scrotum but outside of the normal path of descent.

HISTORICAL NOTE

Baron Haller (4) recognized the intra-abdominal origin of the testes in man and in his *Opuscula Pathologica* written in the year 1755 describes the descent of the testis into the scrotum during intra-uterine development and accurately describes the original relations of the testis to the peritoneum and the abdominal viscera. He applied this knowledge to the explanation of congenital inguinal hernia, a subject in which he was deeply interested.

In 1762 Hunter (5) described the situation of the testis in the fetus and its path of descent to the scrotum. In his *Commentaries* the subject of undescended testes was first dealt with exhaustively. Hunter also reported two cases of congenital perineal testes which came under his observation.

As far as is known, Koch of Munich, in 1820 was the first to employ surgical means for the correction of undescended testicle.

Prominent among the early writers on this subject are Gowers, Goddard, Curling, and Lockwood. Among the more recent writers the names which should be especially noted are those of McAdam Eccles, 1903 (Jacksonian Prize Essay); Odiorne and Simmons, 1904; Coley, 1908; Davison, 1911; Mixter, 1916; and Bevan, 1918.

STATISTICAL DATA

Among the statistical data collected by the War Department (13) from the draft records of the physical condition of men registered and examined pursuant to the requirements of the selective service act, the figures regarding the occurrence of monorchism and cryptorchism are of interest.

The total number of these cases was 8,538 or 3.1 per thousand men examined. A consideration of the published tables and charts indicates that these conditions are most common in the northwestern states. Thus, the largest number of these defects were found in men from Minnesota, Montana, Colorado and South Dakota, the incidence in these states being closely followed by that in Idaho, North Dakota, Washington, Oregon, Wisconsin and California. On the other hand, men from the southeastern states showed the smallest proportion of these defects; thus the smallest incidence was found among the men from Alabama, North Carolina, Georgia, Florida, Louisiana, Arkansas, Tennessee, and Mississippi.

In the more densely populated eastern states such as Rhode Island, Massachusetts, and Connecticut, the incidence was much higher than in such sparsely settled states as Arizona, Kentucky, Wyoming, and New Mexico.

An examination of the distribution of monorchism and cryptorchism as indicated by the above statistics suggests that the high incidence in the northwestern states and in the more densely populated parts of New England is due to some racial peculiarity. These defects are believed to be relatively uncommon in the colored race which would account for the comparatively low incidence in the southeastern states. Geographically, the intermediate states in which there is a comparatively small proportion of foreign and negro population showed a relative intermediate incidence of these abnormalities. In the official statistical reports no reference is made to the incidence of ectopic testis.

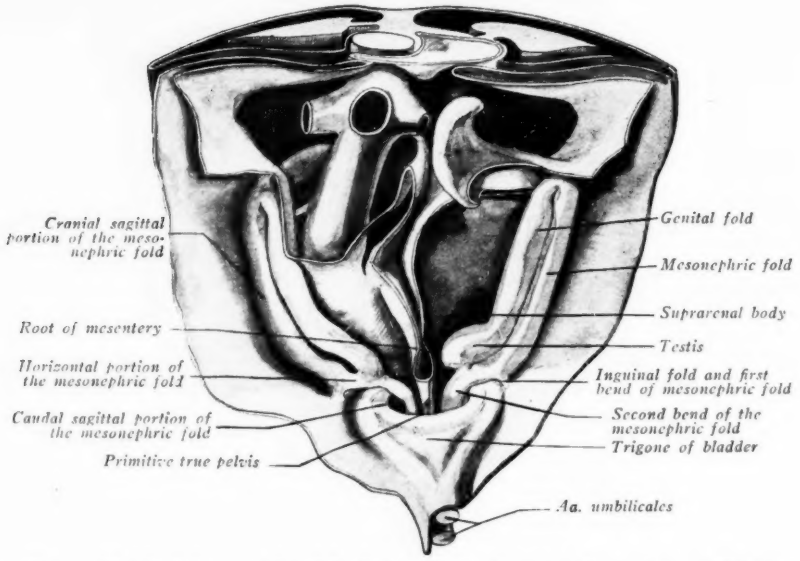
Cranial sagittal portion of the meso-nephric fold
Root of mesentery
Horizontal portion of the mesonephric fold
Caudal sagittal portion of the mesonephric fold
Primitive true pelvis
Genital fold
Mesonephric fold
Suprarenal body
Testis
Inguinal fold and first bend of mesonephric fold
Second bend of the mesonephric fold
Trigone of bladder
Aa. umbilicales

Fig. 1. Model of the posterior abdominal wall of a human embryo of 19.4 millimeters greatest length. (From the collection of Professor Hochstetter, Vienna.) The mesonephric fold is bent at two places, and the upper sagittal, horizontal, and lower sagittal portions can be seen. (Redrawn from *Human Embryology*, Keibel and Mall.)

EMBRYOLOGICAL DATA

The wide divergence of opinion regarding the etiology of maldescended testes from the time of Curling (1841) to the present is indicated by Coley (2) in his review of the literature in his article on the association of this condition with inguinal hernia. That the subject has not been adequately studied by many of those who have ventured opinions is apparent.

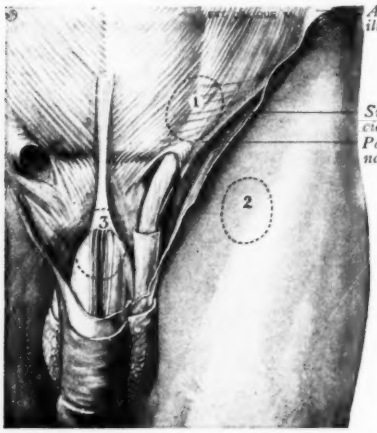

Fig. 2. Schematic drawing showing attachment of membranous layer of superficial fascia. 1, interstitial ectopic testis; 2, femoral ectopic testis; 3, penile ectopic testis.

Because the anomaly is always of congenital origin it occurred to the writer that a brief review of the normal embryological processes which are concerned in the genesis of the testis and its subsequent movement from within the abdomen to the scrotal sac might be helpful.

At a period when the embryo is still a more or less flat three-layered disk, the middle mesodermal plate splits medially toward the midaxial line and the first vestige of the cœlomic cavity (the exocœlom) becomes manifest. At first the latter appears as an angle between the visceral mesoderm and the parietal mesoderm. Soon there appears a longitudinal fold or thickening of the parietal mesoderm at a short distance lateral to the midline and this fold as it continues to develop bulges forward and invaginates the early cœlomic cavity. This fold is known as the urogenital

fold (gonephrotome) because from it are derived in rapid succession the tubules of the three excretory organs and the genital gland. The urogenital fold gradually extends from the fourth cervical segment to the second or third lumbar segment. A definite stage of maximum extent, however, does not occur for the reason that degeneration at the cranial end accompanies caudal growth. As it continues to develop the urogenital fold undergoes a series of important changes. In the first place, with the exception of the cranial and caudal ends it becomes divided throughout its whole extent into a medial genital fold and a lateral mesonephric fold (Fig. 1). After the reproductive gland (genital fold) is formed the latter becomes surrounded by a fossa, deep grooves cutting into it medially and laterally. These grooves, however, never meet and the portion of mesoderm persisting between them gives rise to the stalk of the genital gland known as the mesorchium. The maximal extension of the anlagen of the genital gland is from the sixth thoracic to the second sacral segment but eventually, as a result of the degeneration of ten or eleven segments from above downward, it extends only over three or four segments. Internal "descent" of the testis, therefore, never exists. What seems to be a descent is actually a shortening.

As new structures appear between the two urogenital folds the latter which were parallel to the vertebral column become displaced. The growing suprarenal bodies force the folds of opposite sides apart and this process which is started by the suprarenal bodies is continued by the intestinal tract; but caudal to the metanephros the spreading force ceases to act and the urogenital folds are not displaced. As a result of displacement above and absence of displacement below the folds are bent characteristically.

Before bending of the body wall is fairly initiated there appears on the lateral surface of the first bend of the metanephros a knob-like outgrowth — *the inguinal fold* — which reaches out in the direction of the rudimentary lateral (later anterior) body wall. The lateral abdominal wall on its part at a point almost exactly opposite in the same horizontal plane projects a similar knob-like outgrowth—*the inguinal crest*—which is directed medially. The inguinal fold continues to grow in the direction of the inguinal crest and the inguinal crest continues to grow in the direction of the inguinal fold so that eventually the two meet and fuse. In this manner is established what to all intents and purposes is a bridge connecting the urogenital fold with the lateral abdominal wall at a point upon the latter which marks the site of the abdominal inguinal ring. In the interior of the inguinal crest there is from the beginning a cord of compact mesenchyma—*the chorda gubernaculi*—which is evident before there is any indication of a differentiation of the abdominal musculature. In transverse section this cord has a conical shape with its apex directed toward the inguinal fold and with its base almost at the integument. When later the abdominal musculature begins to differentiate it must of necessity grow around the chorda gubernaculi and in this manner the inguinal canal is formed. In the male the union of the gubernaculum with the mesonephric fold is exactly opposite the insertion of the ligamentum testis (Fig. 3) and in the portion of the mesonephric fold between these two insertions there develops another mesenchymatous cord which connects with the ligamentum testis and with the chorda gubernaculi and so unites the two. As the result of this last union there is formed a continuous cord extending from the lower pole of the testis through the inguinal canal and terminating in the integument at the base of the genital tubercle, later the depths of the scrotal sac. The chorda gubernaculi then, is in effect a fibrous and muscular cord which marks the path traversed by the testis in its descent. Two processes act now to alter the comparatively simple relations which have just been described. First, the anterior body wall is brought up from a horizontal to a vertical position; and second, the loops of intestine which lie in the exocœlom are taken into the body cavity as it forms. These processes are orderly and synchronous and depend on uniform principles of development. It is necessary that the cœlomic cavity be sufficiently large to contain the loops of intestine and this is effected by enlargement of the sagittal diameter,

whereby the interval between the anterior and posterior abdominal walls is increased. Since the lower pole of the testis is connected with the anterior abdominal wall by its chorda gubernaculi, it is plain to see that as the anterior abdominal wall becomes progressively more separated from the posterior abdominal wall the testis likewise must of necessity become more separated from that wall. As the lateral (later the anterior) abdominal wall moves forward the chorda is first made taut and then the caudal pole of the testis is gradually directed ventrally by virtue of the stress which is transmitted to that pole by the medial insertion of the chorda. As a result of this tension the long axis of the testis becomes changed from a vertical to a horizontal position and the testis is passively and progressively moved in the direction of the abdominal inguinal ring. In the seventh month the testis moves down through the inguinal canal (true descent), and the final position of the testis in the testis sac is acquired in the eighth month or at the latest just before birth.

The saccus vaginalis is commonly considered to be an invagination of the peritoneum through the abdominal wall but that it is not primarily an invagination is certainly true. What really occurs is this—when the abdominal musculature is differentiated the peritoneum which lies before the chorda becomes enclosed in a sac-like pocket within the inguinal canal; for it must be recalled that the thickening of the anterior abdominal wall does not affect the point through which the gubernaculum passes. Thus, the abdominal wall grows around the saccus. It is true, however, that the vaginal process of the peritoneum does make its way on through the inguinal canal to the bottom of the testis sac but how this comes about has not yet been made clear.

On the basis of this embryological consideration let us now see whether the various types of maldescent on the part of the testis are really so difficult of explanation as they have appeared to be.

MECHANICAL FACTORS WHICH PROMOTE OR INTERFERE WITH THE DESCENT OF THE TESTIS

As has been noted above, in embryonic development there is a period during which the lateral (later the anterior) abdominal walls grow rapidly and bend ventrally to fuse in the midline, thus enclosing the abdominal viscera. How this movement affects the movement of the testis into the internal abdominal ring has already been discussed. In certain cases coincident with the crowding of the viscera into the cœlum cavity pressure is brought to bear upon the reproductive gland by the stomach and intestines in such a way that the gland fails to make its normal connections in as far as the inguinal fold and the inguinal crest do not come together and fuse, and in consequence the testis in turn is not directed into the inguinal canal. That such an occurrence would result in the abdominal retention of the testis is of course apparent. It would seem as if many cases of cryptorchidism might be explained in this manner.

While one would hesitate to say that all cases of abdominal retention of the testis occur in this manner, it would seem probable that they are due either to such a circumstance as that described above or to some anatomical or physiological deficiency in a chorda which has actually formed. Such an anatomical deficiency might be said to exist in the instance of a chorda gubernaculum which is so long that the lower pole of the testis is not brought up sharply to the internal abdominal ring but is allowed to sag away from it. Or the chorda instead of differentiating into a structure capable of withstanding the strain to which it is destined to be subject may differentiate into a structure incapable of withstanding the stress put upon it without stretching so that the testis fails to come into the internal ring (Fig. 4, c). Although it is not definitely known to what extent the smooth muscle constituent *per se* of the chorda influences the direction of the testis into the ring, nevertheless, it would seem reasonable to think of it as a factor of safety in the absence of which the testis may be left behind. Nor is it inconceivable that under stress the chorda might separate at a point of local weakness between the testis and the integument so that the testis would be left behind (Fig. 4, *b*).

Usually abdominal retention of the testis has been explained as the result of peritoneal adhesions wherein it is supposed that inflam-

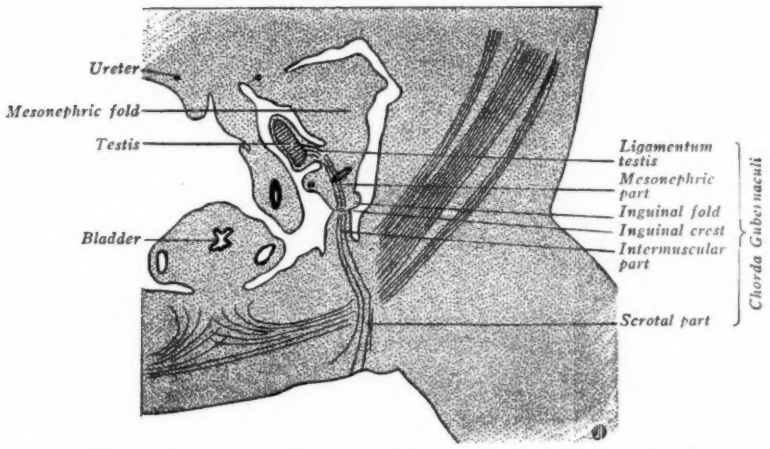

Fig. 3. Diagram of a transverse section of the urogenital fold, of the inguinal fold, and of the body wall of a male embryo of 26 millimeters greatest length, showing the various parts of the chorda gubernaculi. (Redrawn from *Human Embryology*, Keibel and Mall.)

matory processes have bound the testis and peritoneum together behind the internal abdominal ring. The possibility of such a circumstance must be remote.

The true descent of the testis begins only after its entrance into the abdominal inguinal ring. If the progress of the testis downward is arrested at any point within the inguinal canal then an inguinal retention may be said to exist.

The peculiar passive force which was interpreted in terms of growth and which served to bring the testis into the abdominal inguinal ring no longer acts after the testis has entered the inguinal canal. In order that the testis may continue to move downward through the canal, three forces, it is believed, are brought into play. These forces are: (1) intra-abdominal pressure; (2) intermuscular pressure; (3) active contraction of the smooth muscle constituents of the chorda. That the factor of intra-abdominal pressure is a very real one is obvious, if we are to profit by what we recognize as the cause of the common, though unnatural, descent through a like channel of a loop of intestine or a portion of omentum in the form of a hernia. In a similar manner hardly any one would question the action of the abdominal muscles in promoting the downward progress of the testis. It is inconceivable that an ovoid body such as a testis, which to all intents and purposes is a foreign body in a potential body cavity (the inguinal canal), should not be moved by the contraction of the muscular walls of that cavity toward an exit if an exit exists, as in this case it does exist in the form of the subcutaneous inguinal ring. The third and final force which acts in moving the testis through the inguinal canal is dependent upon the active power of traction which is exhibited by the smooth muscle of the chorda itself. In the words of Lockwood (Hunterian lecture, 7), "It is irrational to deny this element its function, namely that of traction."

We may safely conclude that the failure of any one of these three forces to act properly may contribute to retention of the testis in the inguinal canal. However, in addition to these there appear to be other possible causes of non-descent of the testis through the inguinal canal which have been overlooked. Thus, if the chorda is subjected to great stress, may not a resultant separation of its fibers or a pulling out of one or another of its insertions cause inguinal arrest of the testis? Or may not the condition be the direct result of an actual insufficiency on the part of an hypoplastic chorda or one which is too fibrous and not sufficiently muscular (Fig. 4, *d,e,f*)?

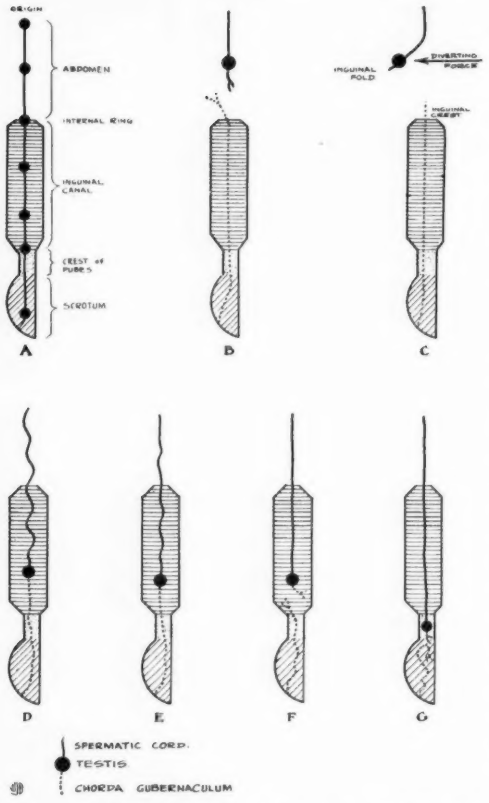

Fig. 4. Schematic drawing illustrating accidents that may occur at various points in the course of descent of the testis from its abdominal origin to its normal position in the scrotal sac. *a*, Progressive stages in normal descent of testis; *b*, abdominal arrest of testis (cryptorchidism) due to fracture of chorda; *c*, abdominal arrest due to pressure of abdominal viscera, making it impossible for inguinal fold and inguinal crest to connect; *d*, inguinal canal retention due to excessive length and laxity of the spermatic cord and gubernaculum; *e*, inguinal canal arrest due to lack of traction power on part of chorda; *f*, inguinal canal arrest due to fracture of chorda; *g*, pubic arrest of testis due to fracture of chorda, provocative factor in production of ectopia.

Immediately upon its escape from the subcutaneous inguinal ring the testis enters upon what may be considered as the third and final stage of its journey from within the abdomen to the depths of the scrotal sac. As has been stated, the first stage of its migration which terminated at the internal inguinal ring was due to certain well defined forces. The second stage—its descent through the inguinal canal—was also due to certain well defined forces. The forces which influenced the position of the testis while it was still in the abdomen ceased to act the moment it came into the inguinal canal, and now in the third stage of its descent the forces which acted in moving the testis through the inguinal canal cease to act when it escapes from the canal. Outside the subcutaneous inguinal ring the testis occupies an interfascial position in contradistinction to the intermuscular one it occupied while it was still within the inguinal canal. In this position it is no longer subject to intra-abdominal pressure acting from above, nor is it subject to the peculiar peristaltic intermuscular force that characterized its passage through the inguinal canal. This third stage of the journey consists of an excursion over the crest of the pubes into the scrotal sac. It is a short trip but a perilous one. Perilous because success or failure of the testis to reach its destination becomes the sole responsibility of the smooth muscle of the chorda gubernaculi. Should the physiological action of the smooth muscle of the chorda be insufficient the progress of the testis downward would be arrested and pubic retention would result (Fig. 4, *g*). If the fibers of the chorda should separate transversely under the stress then the movement of the testis, lying free between the fascial planes, to any point therein, would be limited only by the length of its spermatic cord.

ECTOPIC TESTIS

Occasionally a testis in the course of its migration from the abdomen to the scrotum departs at one point or another from the normal path and comes to rest in a position outside of both the normal pathway and the scrotal sac. Such are the ectopic testes. They form a distinct group of maldescended testes, the members of which are encountered infrequently.

There are four classical types of ectopic testes which in the order of frequency of their occurrence are: (1) Perineal, (2) interstitial, (3) penile, (4) femoral.

In the first three varieties the testis always descends quite normally until it has escaped from the subcutaneous inguinal ring. For

some reason instead of completing its journey over the pubic crest and into the scrotal sac it then moves to some unusual position. Thus, the testis may slip into the perineum; or it may insinuate itself between the aponeurosis of the external oblique muscle and the fascia of Scarpa in the region of the subcutaneous inguinal ring; or it may slide into a fascial pocket on the dorsum of the penis (Fig. 2) or in rare cases the so-called femoral ectopia may develop.

The etiological factors which produce the three more common types of ectopic testis have been more or less obscure. In 1887 Lockwood (7) advanced the theory of multiple gubernacular tails. He considered the gubernaculum as having multiple distal insertions, one of these processes extending to the root of the penis; another into the perineum; another into the femoral triangle; another into the fascial planes in the region of the subcutaneous inguinal ring; and finally he conceived of one process as ending by fixation to the bottom of the scrotal sac. Having imagined the existence of such a chorda it became a very simple matter to explain the occurrence of any variety of ectopia. Thus, perineal ectopia for example, according to this theory, is explained as being due to the development of the perineal gubernacular process in excess of the various other processes, in consequence of which superior traction power the testis is drawn out of its normal path and influenced into the perineum.

The correctness of Lockwood's theory has recently been questioned by the writer (10) who has been unable to find any corroborative evidence either embryological or anatomical for the existence of multiple gubernacular processes. In place of this theory a new explanation was offered which was based (1) upon the presence of a chorda gubernaculi which is functionless following the escape of the testis from the subcutaneous inguinal ring; (2) upon a sufficient length of the spermatic cord to permit the excursion of the testis upon certain well defined fascial planes outside the subcutaneous inguinal ring; (3) upon the peculiarity and constancy of the distribution of fascial planes over the lower part of the ventral abdominal wall and in the perineum, and (4) upon the operation of physical laws which govern a moving body.

It, therefore, became necessary to point out the mechanism by means of which the chorda gubernaculi became disabled after the escape of the testis from the subcutaneous inguinal ring. Such a mechanism must also harmonize with the occurrence of subsequent luxation of the corresponding testis.

Accordingly then, the forces concerned in the movement of the testis from the site of its intra-abdominal origin to the testis sac, together with environmental conditions in the presence of which these forces act, were investigated. It was recognized that the migration of the testis could be naturally divided into three stages which could be conveniently designated as (1) intra-abdominal, (2) intracanalicular, (3) extracanalicular.

The forces which act in normally moving the testis through these three areas were studied individually and collectively and the following interesting observation was made. It was recognized that the contracting chorda gubernaculi which served to bring the testis down was aided and reinforced by other equally well defined forces in each of the upper two areas, but that in the extracanalicular area the chorda functioned quite alone and must of necessity be solely responsible for the movements of the testis through this zone and onward into the testis sac. This observation, it was felt, was especially pertinent to the problem at hand, for it will be recalled that the object of this phase of the investigation was solely to discover any factor which might contribute to, or be responsible for, the failure of the testis to follow the normal path of descent from the subcutaneous inguinal ring.

In the opinion of the writer, in all probability the essential factor was a fracture or transverse separation of the fibrous and muscular elements of the chorda gubernaculi in consequence of the excessive stress upon it. This conception presupposes that the chorda is the sole source of motive force in the extracanalicular area. The testis is the passenger. The force disintegrates. The passenger is stranded.

The accident producing a loss of continuity in the fibers of the chorda is therefore the first essential factor in producing ectopia testis.

The subsequent fate of the testis as far as its position is concerned depends upon certain further factors, some of which are variable, such as the degree of tautness or laxity of the spermatic cord, the degree of development of the superimposed so-called cremasteric muscular loops, and peculiarities of insertion, relationship and continuity of certain fasciæ (Scarpa's, Colles', Buck's), which are fixed and invariable over the lower part of the ventral abdominal wall and in the perineum.

Thus if the spermatic funiculus is extended and taut at the time the chorda breaks, and more particularly if in addition it is equipped with a well developed cremaster muscle, then the probability that the testis will be retracted into the inguinal canal is great.

On the other hand if the spermatic funiculus is lax above and possessed of an illy developed cremaster muscle, then a second essential for ectopia following fracture of the chorda is present and the chance for a luxation to materialize is excellent, because such a testis occupies an interfascial position at this time and is free to move according to the physical law governing the movement of such a body within the limits of an arc prescribed by the available length of its spermatic cord.

Thus the testis may move downward to the scrotal neck only to find conditions unfavorable for entrance into that sac, whereupon following the course of least resistance it slips further down upon the deep surface of Colles' fascia into the superficial sac of the perineum, and becomes a perineal testis.

Or the testis may receive an impetus toward the middle line and with a slight inclination downward be caught up in a fascial pocket on the dorsum of the penis and become a so-called penile ectopia.

The interstitial ectopic testes are those aberrant testes which are found between the fascia of Scarpa and the aponeurosis of the external oblique muscle and commonly close to the subcutaneous inguinal ring.

The fourth and final variety of ectopic testes are those designated as femoral, this term being applied because of the position of these testes in the femoral triangle close to the saphenous opening. The mechanism which brings this about is different from that which produces the preceding three varieties of ectopiæ. Femoral ectopia is due to circumstances which permit the testis to sag retroperitoneally to the region of the femoral ring through which it subsequently herniates distally into the femoral canal.

Because of the tendency of the processus vaginalis to accompany the testis into its unusual position, and because of the frequent failure of its upper portion to become fused to form the normal rudimentum processus vaginalis, congenital hernia of the indirect type which may be actual or potential is a frequent complication of ectopic testis.

In further support of this new accident-gravity interpretation for the occurrence of ectopic testis, the author desires finally to emphasize that there is a physical law to the effect that under gravity a moving body tends always to establish an equilibrium for itself and to come to rest. That there exist several normal fascial recesses or pockets the interiors of which are continuous with the only fascial plane upon which a testis with an inclination to become luxated may move, these pockets thus becoming available to such testes under the influence of gravity, is recognized as is the fact that these fascial recesses are the familiar habitats of the ectopic testis.

It would seem reasonable to conclude therefore that the presence of a testis within the confines of such a fascial pocket is evidence of the successful operation of a law of physics in a definite and favorable environment, and not at all due to the activities of a chorda gubernaculi with multiple distal insertions which cannot be proven to exist.

HISTOLOGY OF UNDESCENDED TESTIS

Sections of undescended testes treated by orchidectomy at the Massachusetts General Hospital have been studied microscopically by Odiorne and Simmons (9), and more recently Uffreduzzi (11) of Carle's Clinic in Turin has made a careful microscopic study of undescended testes. These observers have found constant changes consisting in a variable thickening of the tunica albuginea and of the basement membrane of the tubules, the latter of which is frequently so thickened as completely or partly to obliterate the lumen

of the tubules. The spermatogenic cells or the so-called epithelial cells of the tubules, if present, show marked changes from normal being few in number and of irregular shape. Well formed spermatozoa are almost never present. As for the cells of Ledig, to which the French give the name *glande interstitielle du testicule* and the Germans *Pubertaetsdruese*, it is interesting to note that these elements are present in large numbers.

These changes may be explained as due to chronic inflammatory alterations secondary to the pressure to which the undescended testis is subject. Here as elsewhere the more highly specialized cell elements are first to suffer and as they are destroyed and disappear the space is taken up by lower grade cells according to the phenomena of replacement fibrosis.

EFFECT OF MALDESCENT OF THE TESTIS UPON FUNCTION

Because the testis produces spermatozoa it is known as a spermatogenic gland and because in addition it produces an internal secretion of the nature of an hormone it is also known as an endocrine gland. Therefore, the testis has a dual rôle in the economy of man.

That the removal of the testes in a young individual has a profound effect upon the development of the sexual apparatus of that individual and also a profound influence on his growth and upon his psychology is well known. Under such circumstances the tissues are deprived of the guiding influence of the sex hormone and those characteristics which we recognize as secondary sexual characteristics fail to develop and the individual is a eunuch.

For many years the sex hormone has been thought to have its origin in the interstitial tissue (cells of Ledig) and the experimental work of Ancel and Bouin tended to support that theory. In an admirable review in a recent number of the *Lancet*, however, Mr. K. M. Walker (12) offers a number of very substantial arguments in disfavor of the view that the interstitial cells are solely responsible for the internal secretion of the testis. The question now is very undecided.

We know that irrespective of the position of the testis, whether retained within the abdomen or elsewhere outside of the scrotum, the secondary sexual characteristics do develop and such an individual possesses the habits and desires of a normal male even though he may be a double cryptorchid and sterile.

On the other hand testes which fail to escape from the abdomen, or are arrested at some point in the normal descent, are usually functionless as far as their spermatogenic power is concerned. That spermatogenesis is instituted in all these cases at puberty is probably true; and that spermatogenesis persists in a limited degree for a variable period, which at best is but a few years no doubt is also true. Reference has been made above to the microscopic pathology of undescended testis. The fate of the tubules is known.

DIAGNOSIS AND COMPLICATIONS

The diagnosis of undescended testis is not difficult. The corresponding half of the scrotal sac is empty and atrophic. The condition may be bilateral. Palpation may reveal the testis on the pubic crest just outside the subcutaneous inguinal ring, or its presence in the inguinal canal may often be revealed by tactile sense exerted through the ring or through the tissues overlying the inguinal canal.

A potential hernia exists in practically all cases of undescended testes. This is due to the fact that in such cases the processus vaginalis testis rarely goes through the stages whereby the proximal portion normally becomes closed off to form the rudimentum processus vaginalis testis. It follows that inguinal hernia of the congenital indirect type which may be incomplete or complete, is the most common complication of undescended testes. Other complications are hydrocele of the cord, epididymitis, torsion, and neoplasm of the retained testis. That malignant degeneration is more prone to occur in undescended testes than in normally placed ones is shown quite conclusively by Coley.

TREATMENT

As for the treatment of undescended testis a number of factors must be considered. The

anomaly is congenital and if no complication arises such as those mentioned above, which complication in itself demands operative treatment, there is no occasion for intervention until the child is 10 or 12 years old. As has been stated, the endocrine function of the testis is uninfluenced by its position. Moreover, not infrequently the retained testis finds its way spontaneously into the testis sac during early childhood. Should the child reach 10 or 12 years of age without the testis having found its way into the scrotum spontaneously or by virtue of daily manual traction on the retained testis in the direction of the scrotal neck, then orchidopexy should be done and simultaneously the potential or actual associated hernia should be corrected.

There are very good reasons for advocating the correction of undescended testes at the age of 10 or 12 years. At approximately 14 years of age the child reaches the stage of puberty—the process of spermatogenesis is present in the seminiferous tubules. But spermatogenesis is not initiated abruptly; therefore, it is essential to act well in advance of the earliest manifestation of activity in the tubules. If the age of puberty is reached and passed without the testis having been brought down, then the degree of good so far as the functional result of operation is concerned will vary directly with the length of the period between puberty and the operation; for it appears that nature having been balked originally in the full performance of her duty proceeds to it with increased reluctance as time goes on and eventually proceeds not at all. The age after which no functional benefit may be anticipated as a result of operation has been generally considered to be 21 years. However, one may not always be sure of this point and therefore, the operation should be done irrespective of age in all cases of inguinal retention for in this manner only may the accompanying existent or potential hernia be radically cured and the possibility of malignant degeneration lessened.

OPERATIVE TECHNIQUE

The operative procedure most likely to give the best results is as follows: Through a Bassini incision the inguinal canal is opened in its entire extent. The processus vaginalis is carefully separated from the cord just proximal to the testis and a ligature is laid about it at this point. The processus is then divided transversely just below the ligature and from its lower portion a tunica is made for the testis by the purse string method. The upper portion of the processus up to the inguinal ring is then very carefully separated in the proper cleavage plane from the underlying constituents of the cord. The neck of the empty sac is transfixed and tied and the pendulous peritoneum excised.

The testis and cord are freed from any adhesions which may bind them to the walls of the canal and the adhesions which bind and kink the constituents of the cord together are carefully sought out and divided. In carrying out this latter step gentle traction downward upon the testis will serve to bring into view the offending adhesions and speed should be sacrificed for thoroughness of procedure.

By breaking up such adhesions as may exist and isolating the cord into its component parts usually sufficient length will have been obtained to permit the proper placing of the testis in the depths of the scrotal sac which has been previously invaded with the fingers and stretched vigorously in all directions.

If, however, the cord is still too short to permit the proper disposal of the testis in the scrotal sac, then traction is made on the tie around the peritoneal stump at the internal ring; and by introducing one finger into the abdominal cavity behind the stump the spermatic vessels are further freed as far as possible from the extraperitoneal fat in which they lie. The vas deferens is similarly freed along the course which it pursues downward and backward into the pelvis. Almost always this procedure will lengthen the cord sufficiently to make it possible to carry the testis into the scrotum without tension. Should certain spermatic veins be so short as still to prevent the desired end they may be divided between ligatures. The spermatic artery should be divided only after every possible effort to save it has been made.

In event the cord is still too short the technique of Davison (3) or the Mixter (8) modification of Davison's procedure should be used.

The principle of this technique depends on the direction of the spermatic vessels immediately above the beginning of the spermatic cord at the abdominal inguinal ring, and the possibility of lowering the whole cord by transplanting it through an incision in the transversalis fascia with or without preliminary ligation of the deep epigastric artery. This procedure is hardly ever required, but the advantage it offers should not be lost sight of should the occasion to use it arise.

Having placed the testis in the scrotum without tension, the inguinal canal should be closed, according to the modified Bassini technique without transplantation of the cord. Should the cord be transplanted after the true Bassini method then from 0.5 to 1 inch of the available length of the cord will be sacrificed and that tends to defeat the purpose for which the operation is undertaken. The conjoined tendon is sutured to the inguinal ligament over the cord. Especial attention is used in placing the lowermost suture which should catch up the conjoined tendon, and the reflected portion of the external oblique muscle and the inguinal ligament. Provision is thus made for a very small subcutaneous inguinal ring which is desirable, should retraction of the testis occur.

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SOME OBSERVATIONS ON THE ENTRANCE OF BILE INTO THE DUODENUM

By A. WINKELSTEIN, M.D., New York City

From the Medical Department of the Mount Sinai Hospital

It was suggested a year ago[1] as a result of some experiments on the dog that "the respiration is the motor of the gall bladder." Since then further studies on this subject have been made in the Department of Experimental Pathology at Columbia University. In a series of articles to be published[2] there will be found a complete discussion of these experiments and their significance. The pertinent conclusions, however, will be mentioned here.

[1] Winkelstein, A. J. Am. M. Ass., 1923, lxxx, 1748.
[2] Winkelstein, A., and Aschner, P. W. To be published in the Am. J. M. Sc.

The importance of the increase in the intra-abdominal pressure due to respiration has been confirmed. From a study of the differential pressures existing in the biliary duct system, it has been demonstrated, furthermore, that the rise in the pressure within the gall bladder resulting merely from the increase in the tonus of its musculature and elastica (no gross contractions were ever observed) is not enough, even when the sphincter of Oddi is relaxed, to force bile from the gall bladder into the duodenum. On the other hand the intra-abdominal pressure at the end of a

normal inspiration is sufficient to express some bile from the gall bladder into the duodenum when the sphincter is relaxed. That an increase of the intra-abdominal pressure actually does squeeze some bile out of the gall bladder into the intestine has been demonstrated by our experiments in which dyed bile was forced from the gall bladder into the duodenum with each inspiration when the sphincter of Oddi was kept patent by means of a small glass cannula.

It was found possible, furthermore, to empty the gall bladder by increasing pressure on the gall bladder manually. For, after giving atropin to relax the sphincter of Oddi, vigorous lateral pressure on the lower thorax and upper abdomen caused an almost complete expulsion of the bile from the gall bladder into the duodenum. Abramson, working independently in the same laboratory, had made similar observations with roentgenographic studies.[1] He was able under the fluoroscope, to squeeze manually out of the gall bladder a roentgen-opaque solution (neosilvol) into the duodenum even without previous relaxation of the sphincter of Oddi.

The quantity of bile expelled into the duodenum depends on several factors: (1) the degree and duration of the relaxation of the sphincter of Oddi, (2) the increase in the intra-abdominal pressure, (3) the quantity of bile in the gall bladder, (4) the elastic tension of the wall of the gall bladder, or, perhaps better expressed, the hug of the wall about its contents, and (5) the position of the gall bladder especially with reference to the line of its axis with the cystic and common ducts.

Experiments and clinical experience have shown that the first three factors are more or less readily controllable. The fourth, viz., the tension of the wall, probably depends on the individual elastic and muscular arrangement and irritability, on the quantity of bile present, and on the innervation tonus. While it is perhaps important, it is obviously difficult to control. In regard to the last factor, the position of the gall bladder, there appears to be much individualization. In fact, all degrees from an axis which is almost in a straight line with the cystic and common ducts to extreme angulation may be encountered. Obviously, the less kinking, the more easily will the gall bladder be emptied. It may very well be that this variability in position is the most important factor, either temporary or permanent, in changing the rate of emptying as well as filling of the gall bladder in any given instance.

From a consideration of these experimental and theoretical observations a simple method of obtaining bile from the gall bladder suggests itself. Reduced to the simplest terms, the procedure consists in increasing the intra-abdominal pressure and relaxing the sphincter of Oddi simultaneously. The technique which we have employed in obtaining bile from the gall bladder of patients is as follows. The duodenal tube is passed in the morning through the fasting stomach in the usual fashion. After the entrance of the bucket into the duodenum, a duodenal specimen is collected by siphonage or aspiration. Sixty to 70 cubic centimeters of warmed 25 per cent magnesium sulphate (3 per cent peptone solution or olive oil may be substituted satisfactorily) is injected, 5 minutes being consumed by this injection. This solution is then allowed to siphon off for 5 minutes. The patient is now placed in moderate Trendelenburg position and various maneuvers used to increase the intra-abdominal pressure. The following may be tried successively (1) very deep inspiration and expiration, (2) coughing, (3) a prolonged expiration followed by a cough, (4) anteroposterior pressure in the region of the gall bladder with the vigorous use of the palms of both hands, (5) squeezing the lower chest wall laterally while the patient or an assistant holds the palms of the hands firmly over the epigastrium, (6) bending the upper trunk on the abdomen, and (7) combinations of the above. During these manipulations, the bile is, of course, collected and observations of the gross and microscopic characteristics of the specimen are made.

A discussion of the appearance of bile, especially the color, will be found in the publications containing the experimental data. It should be mentioned here, however, that, while the dark brown or greenish brown bile (mixed gall-bladder and liver bile) is ap-

[1]Abramson, H. A. Proc. Soc. Exper. Biol. & Med., 1924, xxi, 407.

parently always present in the common duct of the fasting animal, yet, after the bile enters the duodenum, the chemical and diluting factors there may cause considerable change in its appearance. Nevertheless in nearly all normal fasting patients, the dark specimen is recovered after the instillation of magnesium sulphate and the subsequent manipulations to increase the intra-abdominal pressure. Microscopic examination of sediment after centrifugalization at high speed for 15 minutes, seems to be of greater diagnostic importance.[1]

We have attempted during the past year to confirm this test in the human by the use of dyestuffs. During the animal experiments and in some studies on cholecystectomized humans, it was found that intravenous phenoltetrachlorphthalein was almost completely excreted in the bile within 2 hours, a very faint trace persisting for 24 to 48 hours. This dye was injected in a series of fasting patients and several hours later the test, as described above, performed. In some cases, the Meltzer-Lyon technique was employed without the manipulations to increase intra-abdominal pressure. The dark specimen contained a heavy trace of dye. After increasing the intra-abdominal pressure, the specimen obtained, dark or light, contained a still larger amount of the dyestuff. This seems to indicate that the specimens containing more than a faint trace of dye stuff came from the gall bladder.

[1]Lyon, B. B. V. J. Am. M. Ass., 1919, lxxiii, 980.
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A further attempt to investigate the experimental and theoretical foundations of the test is being made now by means of roentgenographic studies of the gall bladder as visualized after intravenous phenoltetrabromphthalein (Graham).

Although our clinical experience with this method is as yet insufficient to warrant a discussion of its comparative value, yet the results in 28 cases thus examined indicate that the amount of gall-bladder bile and sediment is larger than may be obtained by the methods known at present. There is also the possibility, which we have not yet encountered, that bile, otherwise unobtainable, may be secured from the gall bladder in this manner. It appears to be applicable not only in the diagnosis but also in the prophylaxis and therapy of the diseases of the biliary tract.

SUMMARY

Observations on some experimental studies on the entrance of bile in the duodenum are mentioned. Apparently an increase in intra-abdominal pressure squeezes bile out of the gall bladder into the duodenum when the sphincter of Oddi is relaxed. It is suggested that, in addition to relaxing the sphincter of Oddi by the administration of magnesium sulphate, manual and other methods (coughing, bending, deepened respiration) to increase the intra-abdominal pressure may prove to be of value in obtaining bile from the gall bladder of patients.

INSULIN–GLUCOSE TREATMENT OF SURGICAL SHOCK AND NON–DIABETIC ACIDOSIS[1]

By DAVID FISHER, M.D., and EDMUND MENSING, M.D., Milwaukee, Wisconsin
From the Surgical Section of the National Military Hospital, Milwaukee, Wisconsin

ONE of the major difficulties that may arise as a consequence of the administration of an inhalation anæsthetic is postanæsthetic toxæmia (12). Acetonuria, acetonæmia, and acidosis are terms applied to undesirable, delayed, or postanæsthetic effects. The symptoms of a pre-operative or postoperative acidosis include vomiting, acetone bodies, flushed face, dry lips, weak rapid pulse, restlessness, and unconsciousness. These effects are somewhat more pronounced with chloroform than with ether, and many deaths have been reported due to postoperative acidosis (3). Ethylene seems to diminish to a large degree the tendency to postoperative vomiting.

When we consider the causative factors of a pre-operative acidosis, we are compelled to include in our determinations the surgical condition, usually acute in nature, that the acidosis accompanies. It is evident that this is a very serious matter, not only because the patient has an acidosis, but because in the large majority of cases immediate surgical intervention is necessary, necessary in spite of the contra-indication present. Again, a condition of acidosis once established, if persisting, leads to a vicious circle of cause and effect, which may be severe enough to produce coma and death.

Acidosis, as is well known, is accompanied by a lowered alkaline reserve, which in ether anæsthesia, amounts to an average loss of 15 per cent of the reserve (16). The lowering can be caused by disturbed metabolism, starvation, diminished elimination, hæmorrhage and shock. Many surgeons look chiefly for acetonuria, but the acetone bodies do not account for the entire lowering of the alkaline reserve (8, 11, 15).

The former methods of treating a pre-operative or postoperative acidosis have been very uncertain and very unsatisfactory, the general treatment being glucose and alkalies with the usual supportive measures added. I wish to tell you this evening of the results I have obtained in pre-operative and postoperative non-diabetic acidosis by a very simple procedure based upon a scientific, physiological rationale; and of how this same rationale applies to surgical shock, for here the physiological background is very similar. The treatment, practically specific in nature, consists of the intravenous injection of glucose and the subcutaneous injection of insulin.

The action of insulin in the treatment of diabetes is well known, and its specificity in the acidosis and coma complicating this has been sufficiently demonstrated to give it a distinct clinical basis. Since insulin causes such a rapid disappearance of diabetic acidosis, it first occurred to Thalhimer (17) that the various types of non-diabetic acidosis might be treated just as successfully, and in a recent publication, he gave a new impulse to the use of insulin by reporting three cases of postoperative acidosis treated with insulin in which there was almost an immediate cessation of vomiting and ketosis. The results obtained were more rapid and more certain than by the use of glucose alone. This immediately opened a large new field for the therapeutic use of insulin, one unforeseen by its original investigators, and if properly placed upon a distinct clinical basis, puts into the hands of the surgeon a potential remedy for a complication most feared heretofore.

A short time later it was my privilege to observe three cases of pre-operative acidosis due to starvation and incessant vomiting induced by acute abdominal conditions. The following report of these cases[1] which appeared in the recent literature (9) shows how specific the action of insulin and glucose is in this type, as specific as in the cases of postoperative acidosis which have been reported by Thalhimer.

[1]The authors have treated 19 cases successfully.

[1] Read before the joint meeting of the Chicago Medical Society and the Chicago Society of Anæsthetists, Chicago, November 19, 1924.

CASE 1. H. T., male, age 27, admitted to the National Military Hospital August 17, 1923, had had severe abdominal pain and vomiting for 6 days before admission and had eaten no food during this time. The temperature was 100.8; pulse, 110; respiration, 24. He had a severe chill lasting 8 minutes. The abdomen was tense and rigid, with generalized tenderness. The urine was acid and amber colored, the specific gravity was 1.028, acetone was 3 plus (sodium-nitroprusside test); diacetic acid, 3 plus (ferric chloride test); there was no albumin or sugar. The breath had an odor of acetone. Under a local anæsthetic a gangrenous appendix was removed, and drainage instituted.

After the abdominal incision was closed, the patient was given 500 cubic centimeters of a 10 per cent glucose solution intravenously, so that the entire time of administration consumed 1 hour and 10 minutes. Soon after the glucose was started, 20 units of H-20 insulin, Lilly, was given hypodermically, and another 20 units at the end of administration. At the same time sodium bicarbonate was given rectally. Two hours after the glucose was given, vomiting ceased, and the acetone and diacetic acid were reduced to 1 plus; 500 cubic centimeters of glucose were given again and 15 units of insulin at the beginning and end of administration. Three hours later, the acetone and diacetic acid had entirely disappeared from the urine, but there was a trace of sugar present. The well-being of the patient was 100 per cent improved. He refused any food for the next 36 hours, and at the end of this time, the urine showed acetone 2 plus. This was quickly controlled with 500 cubic centimeters of glucose and 20 units of insulin. Convalescence from here on was uneventful.

Pre-operative acidosis, when present, is a severe complication of the surgical condition that it accompanies in the majority of cases. Theoretically, this is a contra-indication to immediate surgical intervention, and does not give the surgeon much choice in the matter because of the severity of the pathological condition present, and the former methods of treating the acidosis with or without alkalies, were at their best time-consuming and always uncertain as to results, especially when the acidosis is intensified by the operation.

The second case of pre-operative acidosis in our series demonstrates the specificity of the insulin-glucose method of treatment even more emphatically.

CASE 2. A. A. H., male, age 46, admitted to the hospital December 22, 1923, had for 2 days suffered with severe, colic-like, abdominal pain, beginning in the epigastrium and radiating to the right and left upper quadrants. Practically no food had been taken for 4 days before admission, and vomiting had been incessant for the last 48 hours. Jaundice was generalized and intense. The temperature was 99, pulse 60, respiration 22. The patient weighed 278 pounds (126 kilos). The abdomen was full, protuberant, tense and rigid, with generalized tenderness and muscle spasm. The urine was amber, clear; acid, 24; acetone ⅛ plus; diacetic acid 3 plus, no albumin or sugar. The breath had a strong odor of acetone. One hundred cubic centimeters of a 10 per cent glucose solution were given intravenously so that the time of administration consumed 1 hour. Five minutes after the glucose was started, 15 units of U-20 insulin were given, and 15 additional units at the termination of the administration of the glucose. Three hours later, under ether anæsthesia, the patient was operated upon, and the urine examined at this time showed acetone 2 plus and diacetic acid 1 plus. Sugar was now present in the urine. Nine hours after the operation the acetone was 1 plus and diacetic acid was absent, with a slight trace of sugar in the urine. Eighteen hours following the administration of the glucose and insulin, the urine was entirely free from acetone and diacetic acid, with a slight trace of sugar still present, which subsequently disappeared. The patient did not once vomit from the time the insulin and glucose were given, and convalescence was uneventful.

Thus, in this particular instance, a comparatively poor surgical risk was quickly transformed into a fair or good risk. It is not at all necessary to wait for the disappearance or diminution of the acetone and diacetic acid from the urine before proceeding with the operation, and when the time element is an important factor, this procedure can be carried out during the course of the operation; for in the cases thus far recorded, the action of the glucose in combination with the insulin has been specific and can be depended upon. Since glucose is in itself a diuretic and tends to deplete the body tissues of their fluids, it is our custom to administer fluids by rectum simultaneously with the administration of the insulin and glucose.

We had the opportunity to compare this method with that of glucose alone in another patient:

CASE 3. Following a closure of a gastro-enterostomy, the patient developed an acidosis, in which the urine showed a 2 plus acetone and diacetic acid, and 2000 cubic centimeters of a 5 per cent glucose solution was given rectally, all being absorbed, and 24 hours later, the urine still showed acetone 2 plus, which immediately cleared up when 15 units of U-20 insulin were given.

As compared with Cases 1 and 2, a greater length of time was consumed, and yet the glucose alone did not clear up the condition, even though of a milder grade; and not until the insulin was given did the ketosis disappear. This would seem to indicate that insulin is the essential factor, and that glucose-insulin is much more efficacious and rapid than glucose alone.

I will not bore you with the details of the other cases treated with insulin and glucose except to say that the results were rapid and specific, and in one instance we feel that the method was a life-saving measure.

Thalhimer previously observed the effects of the administration of glucose alone in one of his patients. The ketosis still persisted, and only after the addition of insulin were the desired results obtained, and obtained rather quickly. Which of the two factors, insulin or glucose, is the more important, it is difficult to say; however, the combination of the two seems to be specific, whereas with glucose alone the results are uncertain. To give insulin alone is really dangerous because we assume the presence of a sufficient available quantity of carbohydrate in the body which is usually not the case in these non-diabetic conditions.

The exact nature of the ketosis is still unknown; however it seems that the primary factors are either insufficient carbohydrate intake or perverted carbohydrate metabolism, or a combination of the two. In the diabetic type of acidosis, ketosis is present when the perverted body metabolism can no longer utilize sufficient carbohydrate to oxidize the fats completely, or when there is an insufficient carbohydrate intake. In the non-diabetic type of acidosis under discussion, we are dealing with a vicious circle; vomiting occurs, preceded or followed by ketosis, preventing carbohydrate intake necessary to burn fats, with a resultant aggravation of all symptoms.

It appears clinically, that in the perverted body metabolism, carbohydrate cannot be utilized as quickly or as satisfactorily as in an individual with normal metabolism. It seems that the introduction of the insulin supplies the unknown factor in non-diabetic acidosis to make immediately available for body needs the introduced carbohydrate. Since time is always an important factor in pre-operative or postoperative acidosis, the tremendous advantage of insulin and glucose over glucose alone can be readily appreciated.

In the method of the combined administration of insulin and glucose in the treatment of non-diabetic acidoses, it seems that we have a therapeutic vehicle almost specific in action, effective in a very short period of time, which can be repeated as often as is necessary. At the will of the operator it seems to control the very delicate metabolic balance of the organism, as in our first case, in which, after 36 hours of no food intake the acetone again appeared but was immediately driven off by another injection of insulin plus the intravenous administration of glucose. It is an established fact that insulin causes a rapid utilization of carbohydrate in diabetic persons and that the severe vomiting in non-diabetic acidosis causes a decrease in the available carbohydrate; hence it seems that a combination of the factors is scientifically sound in the therapy of the acidoses, and the cases thus far recorded demonstrate this.

When one dares to speak upon the subject of shock, he treads upon dangerous ground, and sails upon a poorly charted sea. But this very lack of definite knowledge is the impressive reason why we should attempt to correlate, now and then, all the available information upon the subject, with our continual clinical advances, and see if we cannot arrive at some happy medium establishing a rationale in the treatment of it.

Shock or exhaustion may be produced by various causes such as fear, worry, physical trauma, toxins, infection, hæmorrhage, excessive muscular exertion, starvation, and insomnia. The exact mechanism or physicochemical changes taking place in the production of shock are unknown. The theories explaining this are legion and need not be detailed here for the purposes of this discussion, except to mention briefly that the blame has been laid to capillary distention, dilatation of the splanchnic vessels, fat embolism, absorption of toxins from traumatized tissues, etc. Whatever the cause or

mechanism, the clinical pictures seem to be identical. When we consider the histological pathology of shock, we are on a little firmer ground. The organs especially involved in shock are the thyroid, adrenals, brain, liver, and muscles. This constitutes, figuratively speaking, our kinetic system, which contains potential energy delivered as a result of environmental stimuli. Crile (5), working with animals, has shown that constant stimuli sent to the organs of the body involved in shock cause a hyperchromatolysis, then a hypochromatolysis of the cells, or in other words, a state of exhaustion. He then showed that the brains of humans dying of infection and eclampsia show the same condition. In other words, shock may be considered as the result of an intense stimulation of the kinetic system by physical exertion, emotion, trauma, toxins, anaphylaxis, etc., which leads to physical changes in the kinetic system, and which, if carried far enough, exhausts that system. The kinetic system continues to be activated so long as there is life, but normal activation does not produce exhaustion. The difference between normal processes is one of intensity and not of kind.

The theoretical and laboratory aspects of this problem have recently been further studied by Levine, Gordon, and Derrick (13) working at the Peter Bent Brigham Hospital in Boston. They studied the changes in the chemical constituents of the blood following a Marathon race, and showed that a correlation existed between the blood sugar level and the physical condition of the runner at the finish. Those who had a normal blood sugar content showed no signs or symptoms of shock. Four runners who were markedly prostrated, and in fact one who was unconscious, had a very low blood sugar, and presented the typical picture of an overdose of insulin with its attendant hypoglycæmia.

With all of this evidence before us, it readily becomes clear that to combat the symptoms of shock rationally we should devise some method whereby the body can be furnished with a substance that will give rise to an immediate supply of energy, and maintain that supply as long as necessary to combat the symptoms of shock.

Having had such excellent results with insulin and glucose in non-diabetic acidoses, remembering Thalhimer's (18) results with insulin and glucose in the acidosis of the toxæmic vomiting of pregnancy, and taking into consideration the work of Crile, Levine, Gordon, and Derrick, I felt that glucose intravenously and insulin subcutaneously, should successfully combat exhaustion or shock and furnish the body immediate available energy. We soon had an opportunity to try this method of treatment. I wish to mention the following cases[1] as being typical of the action of insulin and glucose in our hands in the treatment of shock.

CASE 1. Mr. J. B., age 80, had the second stage of a two stage prostatectomy done. Just before the close of the operation, the pulse went to 170, respiration became shallow, rate 38, the blood pressure fell, pulse became weak, thready, the skin cold, wet, clammy, and we realized that we were dealing with a case of intense shock. The patient was put to bed immediately and given 1,000 cubic centimeters of a 10 per cent solution of glucose intravenously, and 5 minutes after the flow commenced, was given 15 units of U-20 insulin subcutaneously. The injection of glucose was regulated so that the time of flow took one hour. At the end of this time, 15 more units of insulin were given. One hour after the final administration of insulin, the pulse rate and respirations began to fall, and at the end of 4 hours, the pulse rate was 96, respiration 24. The patient sat up in bed and felt no ill effects from the ordeal through which he had just passed. Urine examination at this time showed the presence of glucose, therefore 10 units of insulin were given, and the next morning the patient was sugar free, and convalescence was uneventful.

The result in this particular case seemed to be miraculous, and we can ascribe it to nothing other than the insulin and glucose.

CASE 2. Mr. A. A. was operated upon for periurethral abscess accompanied by extravasation of urine and a deep seated perineal cellulitis. Three hours following the operation, the pulse had climbed from 110 to 160, respiration from 26 to 38. Respiration was very shallow, pulse thready, skin cold and clammy. The temperature was 104.6. We assumed that we were dealing with shock produced by sepsis and trauma; 1,000 cubic centimeters of glucose were given and 30 units of U-20 insulin in two equally divided doses. Two hours following the administration, the patient began to react favorably, and 9 hours following the operation the pulse rate was 102, respiration 26, temperature 102.2, the skin warm, and the general condition excellent.

[1]The authors have treated 22 cases successfully.

CASE 3. Mr. F. P. had an exploratory thoracotomy. Severe hæmorrhage was encountered. The patient was returned to bed in intense shock. The temperature was 96.8, pulse 172, respiration 38, very weak and shallow; 1,000 cubic centimeters of glucose were given and 30 units of U-20 insulin. This patient began to react within 1 hour, and 8 hours later, the temperature was 99.2, pulse 100, respiration 22, and he had completely emerged from the state of shock.

CASE 4. Mr. P. O., age 45, was operated upon for perforated duodenal ulcer. It was found to have perforated into the pancreas, and a good deal of handling of tissues was necessary. When the patient was returned to bed the temperature was 98, pulse 160, very weak and thready, respiration shallow, rate 30. The facies was drawn and pinched. The abdomen was non-rigid and non-tender. He received 1,000 cubic centimeters of glucose and 30 units of U-20 insulin. The reaction was excellent. Three hours later, the pulse was 110, temperature 99.6, respiration 24, and general condition good.

CASE 5. Mr. A. L., age 34, was admitted for acute fracture of the twelfth dorsal spine. All the usual neurological symptoms of a transverse lesion of the cord at this level were present. A laminectomy was performed, and during the operation it was necessary to resuscitate the patient twice. He was returned to bed in intense shock. It was impossible to count the pulse, respiration was 48. 2,000 cubic centimeters of glucose were given intravenously and 60 units of U-20 insulin. Four hours later the pulse was 116, respiration 27, and no more trouble was encountered. Five days later he was again operated upon because of no relief. A completely crushed cord was exposed and the patient presented the typical symptoms of intense shock again. This time 1,000 cubic centimeters of glucose were given with 30 units of insulin, and 5 hours later he was out of danger.

Previous to this time, we had been employing the usual measures in combating shock, such as glucose intravenously, Murphy drip, adrenalin, pituitrin, heat to the body, and Trendelenburg position. The results at best were uncertain, and the time element was much greater. We attempted measures to support the blood pressure over long periods of time by the use of adrenalin emulsified in olive oil, but this was of no avail.

In shock, as in nearly all abnormal conditions, we have a state of perverted body metabolism. In addition to this, the entire system is in a state of exhaustion, and to overcome the exhaustion, a source of energy is needed which will readily give up energy to the dying cells. Glucose administered alone cannot always do this satisfactorily or quickly enough. We know definitely, as a result of the splendid experiments carried out by Ringer (14) that insulin oxidizes glucose, hence the introduction of the insulin causes a rapid oxidation of the introduced glucose supplying energy so sorely needed. Since time is always an important factor in the treatment of shock, the tremendous advantage of insulin and glucose over glucose alone, can be seen. The physiological background of the action of insulin and glucose in shock is the same as in the non-diabetic acidoses, or in the toxæmic vomiting of pregnancy and eclampsia, and I feel that independent clinical investigations will confirm these findings in the treatment of shock.

The value of this method of treatment has recently been confirmed by Ginsberg (10).

He treated a boy, aged 11, suffering with a left Pott's fracture with contusions of the chest and abdomen. The day after the injury the patient vomited incessantly and went into shock. The pulse ranged between 130 and 140, respiration 50 to 55, and the temperature 100. Examination of the urine at this time showed sugar to be present, acetone 4 plus and diacetic acid 4 plus. The blood sugar was 325 milligrams. In the morning 18 units of U-20 insulin were given and 200 cubic centimeters of 10 per cent glucose solution intravenously. The boy ceased vomiting immediately, and at 3 p. m. the urine was negative. The next morning he had fully recovered. In this particular case, there was evidently a sudden serious derangement in the carbohydrate mechanism of the body due to some unknown factor associated with the trauma, complicating the accident. The parents were questioned closely but the history showed no evidence of diabetes.

The sudden recovery with the blood sugar lowered to normal and maintained at normal in the face of a diet rich in carbohydrates, shows this to be the case. Thus, a condition extremely serious and progressing rapidly, was immediately transformed to normal convalescence by the use of insulin and glucose.

METHOD

A sterile solution of glucose is used, preferably of 10 per cent strength. Five hundred or 1,000 cubic centimeters may be given, depending upon the severity of the condition. The usual precautions for intravenous medication are taken. The solution is allowed to flow into

the veins at a very slow rate so that the time of administration is at least 1 hour, the longer the better. The amount of insulin used depends entirely upon the amount of glucose injected. For every 3 grams of injected glucose, 1 unit of U-20 insulin should be used, and if H-20 insulin is used, then 1 unit for every 2 grams. The total amount of insulin to be given should be divided into 2 equal doses, and 1 part given 5 minutes after the beginning of the glucose administration and the remainder at the end of the administration. So long as glucose appears in the urine, one need not fear an insulin reaction, for this acts as a safety guide and shows that there is more glucose present in the blood stream than can be taken care of by the introduced insulin. This glucose can be driven off by the injection of a small additional amount of insulin. It is well to give fluids by rectum at the same time in order to counteract the tendency of the glucose to deplete the tissues of the fluids.

Aside from the above conditions, I have successfully checked the incessant vomiting of acute peritonitis with insulin and glucose. We use it in all of our postoperative stomach cases, particularly in ulcers and resections, feeding the patient through his veins for days at a time. Barbour (2) has administered insulin in 12 non-diabetic cases with good results, 2 cases of malnutrition, 2 of malnutrition with tuberculosis, 3 of malnutrition with chronic bronchitis, 1 of marasmus, 1 of acute inanition, 2 of acute nephritis, and in 1 case of a normal infant.

Insulin and glucose have a distinct field of usefulness in the realm of non-diabetic surgery and its complications, and for that matter the same can be said of general medicine. There are enough cases on record to demonstrate this. It is important to remember in connection with this that certain drugs used simultaneously with insulin may diminish or nullify its action, thereby accounting for some of the uncertain results obtained with it. Burn (4) has shown that the fall of blood sugar is diminished, sometimes abolished, when subcutaneous injection of extract of the posterior lobe of the pituitary gland are given with insulin. Pituitary extract removes the symptoms of hypoglycæmic convulsions and causes a rapid elevation of the blood sugar. The effect of a small dose of insulin is decidedly increased by a previous intravenous injection of ergotoxin. Insulin greatly reduces the hyperglycæmic action of epinephrin. At the same time, I do not wish to leave the impression that insulin and glucose are a panacea for all evils, yet I do wish to say, that in all the cases thus far recorded of pre-operative and postoperative non-diabetic acidosis, and in 6 cases of surgical shock, its action has been specific, certainly far more efficacious and rapid, than by former methods. This does not mean that insulin and glucose will take the place of a blood transfusion in shock caused by great loss of blood, nor does it mean that the acidosis of nephritis will be affected by it, but in the fields discussed this evening, it has already demonstrated its worth.

The question logically arises, and rightly so, what is the rationale behind this treatment.

In the first place, the introduction of the glucose into the blood stream raises the circulating fluid volume, thereby helping to remove the sustaining factor in shock. The introduction of the insulin causes a rapid oxidation of the glucose; in the process of this oxidation heat energy is given off to the cells, which aids them in this time of need to regain their equilibrium and discharge their normal metabolic functions. The body cells when in a normal state possess remarkable powers to adjust themselves to changing conditions, and in conjunction with the buffer salts of the blood stream, can usually emerge from a state of internal asphyxia and acidosis. In shock, I cannot help but believe that the heat energy supplied to the cells by the rapid oxidation of the glucose, at a time when normal oxidative processes are checked or held in abeyance, is a tremendous vital factor in initiating the process of recovery of the cells.

Aub (1) has studied the decrease of the metabolic rate in shock. In 8 cases of severe shock, the average decrease was 33 per cent. He learned that the fall in metabolism was related in a way to the critical level of arterial blood pressure as indicated by the appearance of acidosis. The introduction of the glucose, and its subsequent oxidation, not only serves to raise the pressure, but also to increase the

metabolic rate. In addition we know, from the work of Edwards and Page (7) of Cornell, that the intravenous injections of glucose produce a remarkably improving effect on hypodynamic hearts in which the condition present is that usually found in shock. Irrespective of our theorizing, however, clinically the method appears to be efficacious, and in the final analysis, that must be our chief criterion.

This whole question of insulin in non-diabetic conditions is summed up aptly in a recent editorial (6) in the *Journal of the American Medical Association*. Speaking of the conditions reported as being amenable to insulin and glucose, the editor continues: "More prompt success has been reported by Thalhimer, Fisher and Snell, through the combined use of insulin hypodermically and glucose intravenously." It is far too early to generalize too broadly from the few successful treatments recorded, but there is sufficient background to the project of testing the curative powers of insulin and glucose in the treatment of pernicious vomiting and other comparable conditions to warrant giving it careful consideration. The procedure is not free from some element of danger that should not be minimized. Insulin therapy demands care in the case of the diabetic; doubly great is the need of care in the non-diabetic.

SUMMARY

1. In a series of pre-operative non-diabetic acidosis cases a report of 3 is given. In these insulin was given subcutaneously and glucose intravenously causing a rapid disappearance of the ketosis, far more rapid than by the use of glucose alone.

2. Five cases of surgical shock are reported in which this same medication caused a rapid cessation of the typical clinical symptoms of surgical shock, more rapid and certain than by any methods heretofore tried.

3. Independent clinical investigations along these lines are desired to place this method upon a firm clinical basis.

I wish to thank Col. B. F. Hayden for permission to publish these reports.

DISCUSSION

DEAN LEWIS, Chicago. I am much interested in Dr. Fisher's paper, but I had hoped that he would have more to say about traumatic shock, for dealing with traumatic and anaphylactic shock opens a wide field. I do not believe that anyone has ever shown in animals experimentally the traumatic shock seen in man. In the ordinary traumatic shock the absorption of crushed muscle tissue which Cannon claims is responsible for much of it, does not have time to take place. Traumatic shock is immediate, and this distinguishes it from fat embolism, the so-called toxic, and other types of shock. In the cases of post-operative shock cited by Dr. Fisher, many things should be considered. The incidence of postoperative shock depends a great deal upon the amount of blood lost during the operation, and some of the cases he mentioned, he believed were due to toxic shock. One is inclined to think about shock too much as being mechanical and a subject for blood pressure consideration. Many factors lead to acidosis. Dr. Fisher has always introduced solutions which would raise blood pressure. I use salt solution and Dr. Fisher uses glucose, which may be better, but it is a mechanical factor and does not reduce shock entirely. The gelatin and acacia solution which was recommended during the war was the worst thing ever introduced. If people in shock are kept warm and are properly cared for, they can usually be operated upon safely, but nothing can be introduced into the circulation which will keep up the blood pressure for any length of time.

I wish to emphasize, as Dr. Fisher does, the importance of introducing such solutions very slowly. Many people have been killed by the too rapid administration of such agents. The same holds true of transfusion, for there is great danger of dilating the right heart if fluids are introduced into the circulation too rapidly.

Dr. Fisher's work opens up a new field: first, the mechanical factor of the introduction of insulin, then its biological action upon the glucose. In addition, he has employed good surgery, and good surgery is a very important factor in the glucose and insulin treatment of acidosis and shock.

SOLOMON STRAUS, Chicago. Dr. Fisher's paper is thoroughly logical, but a word in clarifying the acidosis question as seen clinically, might be of value. The acidosis of nephritis is not often seen, but ketosis is frequently seen. Nobody knows today why the antiketogenic and the ketogenic substances must form in order for oxidation to take place. The sugars do not burn n diabetes because of perverted metabolism, they do not burn in non-diabetic acidosis because of perverted metabolism, or because the sugar is not there, and so the use of glucose and insulin in any type of ketosis is certainly indicated. In pre-operative and postoperative acidosis, the indications are all there.

As to the question of diagnosis, men working in a general hospital are frequently called in to see patients after operation, but not frequently enough before operation. Surgeons are very prone to consider every postoperative complication as due to something far removed from the field of operation,

and to send for a medical man who often points out an abscess at the point of operation. Another group of surgeons forget that postoperative acidosis occurs and many cases are diagnosed wrongly because the surgeon has forgotten to smell the patient's breath, or to look at his tongue or to do a urinalysis. The reverse is also true when a diagnosis is made without any basis for it. Postoperative cases should be watched more carefully for acidosis, but in the search for acidosis, one should not forget that many things occur which have nothing to do with metabolism but with surgery.

COL. MYRON W. SNELL, Jacksonville. I am primarily interested in the action of insulin in connection with life insurance work. I was present when Dr. Fisher's work was done; it was his original idea, and he personally carried out the work. The question, whether an applicant for life insurance has ever taken insulin in the treatment of any disease, will soon appear on all questionnaires.

ALONZO C. TENNEY, Chicago. Ether is the anæsthetic most commonly used and is usually employed in all combinations. In the preparation of insulin, it is well known that alcohol and ether play an important part in gathering the insulin from the pancreas, and I wonder whether the hypoglycæmia and the associated clinical complex presented following operation do not arise from a physiological exhaustion of the insulin normally resident in the pancreas, and whether that exhaustion does not manifest itself by the symptoms which have been described. If this is the case, would it not seem the logical thing, and is it not the physiological basis for Dr. Fisher's work, to replace artificially the glucose and insulin to complete the combustion.

McMECHAN, Avon Lake, Ohio. For the reestablishment of the detoxicating influence of the pancreas in the human mechanism, insulin is possibly one of the most valuable contributions ever placed at the disposal of the profession. It is realized more and more that certain toxic and detoxicating functions of the body are dependent upon certain secretions of the body, and that among all of these organs, the pancreas is one of the most wonderful detoxicating influences in the human mechanism.

FISHER (closing). In answering Dr. Tenney's question, we must remember that insulin is prepared outside of the body and the cells of Langerhans are no longer connected to the central and sympathetic nervous systems. I do not believe that Dr. Tenney's assumption is correct, because if so, why should the patient come back to normal metabolism following acidosis or shock. The few units of insulin should not account for this. If the ether had the effect Dr. Tenney mentioned, the result would be fat necrosis and total permanent glycosuria, which would continue indefinitely.

As to the question of traumatic shock mentioned by Dr. Lewis, I have cited several cases that have responded favorably, but the number of cases is still so small that definite conclusions cannot be drawn. It has, however, been proved that insulin and glucose will restore many patients that seem hopeless cases, and this method of treatment has a definite rationale and a physiological basis.

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DIPHTHERITIC VAGINITIS[1]

Report of Two Cases

By ABRAHAM F. LASH, M.D., Chicago
Resident in Obstetrics, Cook County Hospital; Department of Gynecology, University of Illinois

DIPHTHERITIC vaginitis occurs so rarely that it is reportable. One of the following cases is especially worthy of report on account of the various diagnoses made in this particular instance.

Diphtheritic vaginitis occurring during the puerperium has been observed by Nisot (10), Bumm (3), Lop (9), and Williams (18). In 1911, Gide (5), collected 42 cases of diphtheria of the vagina and the puerperal uterus.

Biggs (1) described a postmortem specimen of extensive diphtheritic vaginitis in a married woman, age was not given. She entered Bellevue hospital and was thought to be suffering from alcoholic neuritis but on the third day after admission the nurse noticed an offensive vaginal discharge. Examination showed the vagina to be the seat of diphtheritic inflammation. (No smears or cultures mentioned.) History stated that the patient had been ill for about 3 weeks previous to going to hospital. The temperature on admission was 99 degrees F. in the morning and 104 degrees F. in the evening which continued for 6 days when the evening temperature rose to 105 degrees F. For about 24 hours before death she had a profuse diarrhœa. The specimen was interesting because the uterus and the appendages were perfectly normal although the entire vagina was covered by a very marked yellowish diphtheritic membrane. The lower part of the rectum was also the seat of a recent diphtheritic inflammation.

DeLee (4) and Webster (17) just mention the condition in their textbooks, while Polak (11) in his monograph on pelvic inflammation in women says that diphtheritic vaginitis occurs occasionally as a complication of the exanthemata; that in the chronic form it usually occurs in patches and seldom involves the entire vaginal mucous membrane.

In 1923, Van Saun (14) investigated the literature for the last 30 years and was able to find only 26 cases of diphtheritic vaginitis in children of which few were confirmed by bacteriological examination. Primary diphtheria of the vagina occurred in 6 of the 26 cases; in 15 instances bacteriological examinations were made and in 6 virulence tests were made. The duration of the disease was 1 to 4 weeks. There were four deaths in the 26 cases.

The youngest patient with diphtheritic vaginitis was described by Vasile (15) this year. A 13-month baby, when first seen, had a grayish white membrane over the vulva and the superior portion of the medial part of the thigh. On removing the membrane, bleeding points were left. Klebs-Loeffler bacilli were isolated on culturing the material. Although redness and white patches were first noticed 5 days before and treatment was instituted on the sixth day, the child died of cardiac failure due to the grave toxæmia.

Salmon's (12) case of a woman, 55 years of age with diphtheritic vaginitis, is the oldest reported. She had a melancholia and was in a state institution. During a routine gynecological examination, two small patches on the vulva were observed, but as no constitutional symptoms were present they were disregarded. An epidemic of diphtheria being present in the institution, throat cultures were made and diphtheria bacillus was found. When lesions appeared in the mouth, on the lips, tongue, and hard palate, a few days later, 2000 units of diphtheria antitoxin were given. Seven days later a dense, white membrane covered the vulva, lined the vagina, and the visible mucous membrane of the rectum. There was very little swelling and only a scanty seropurulent discharge. The membrane extended to the cervix the next day when the first rise in temperature occurred accompanied by prostration. Four days later sloughing in the vagina occurred associated with very little pain. Although there was very little pain in the rectum, her mouth was sore and swallow-

[1]Read before the Chicago Gynecological Society, December 19, 1924. (For discussion, see p. 585).

ing was painful. A profuse diarrhœa of a small, watery greenish, offensive stool developed. Cultures for Klebs-Loeffler's bacillus were positive from all sites on the fifth day after the patch appeared. Her condition became worse, heart action becoming irregular, and she died on the sixteenth day after the first patch was seen, although she had received 21,000 units of antitoxin.

Leendertz (6) reported an interesting case of primary diphtheria of the vagina with post-diphtheritic paralysis producing difficulty in drinking, and speech, bilateral ptosis and ataxia in a 5½ year old girl.

Although diphtheritic vaginitis is uncommon, yet the incidence of true Klebs-Loeffler bacillus varies from 0 per cent as reported by Lonne and Meyeringh (8) to 23.3 per cent by Broer. Lietz (7) isolating them in 14.2 per cent and Wauschkuhn (16) in 5.5 per cent. Cases reported early in the literature which were diagnosed on the presence of the membranous lesion cannot be considered because of absence of bacteriological vidence. Other organisms, such as enterococcus, streptococcus, and oidium albicans (13) can also produce membranous lesions.

The histories of the present cases are as follows:

Mrs. B. S. M., No. 899755, a white woman, 44 years of age, entered one of the medical wards of Cook County Hospital on September 26, 1924, with the diagnosis of influenza. She complained of pain "all over" which had been present for 4 days. The onset and course of the condition was as follows: The patient lifted a heavy pail of water on September 22, 1924, when she experienced abdominal cramps and noticed slight bleeding from the vagina. The symptoms continued and on September 25, 1924, 3 days later, she passed several blood clots. The following day she entered the hospital feeling very sick, being nauseated, having vomited once and having a severe headache and backache.

The family and past personal history was unimportant and irrelevant. She had been married for 22 years and had seven full term spontaneous normal deliveries and one miscarriage. Her menses began at the age of 16 years, occurring every 28 days, lasting 4 to 5 days, with no pains. The last period occurred on August 14, 1924. (Five weeks before her present illness.)

Physical examination revealed a well nourished, white female, whose skin felt hot and who appeared acutely ill. Temperature, 103 degrees F.; pulse, 96; respirations, 24. No pathology was found except a serosanguineous, foul, vaginal discharge. The condition was diagnosed threatened abortion with sepsis. She was transferred to pathological obstetrics on Dr. Henry F. Lewis' service. Here I found on examination, no pathology of head, pharynx, neck, or chest. The abdomen was round, soft, flaccid and with striæ gravidarum. The liver, spleen, and kidneys were not palpable. Slight tenderness was present in both iliac fossæ.

Vaginal examination, digitally, found the external genitalia without any pathology; the perineum relaxed; moderate cystocele. The vagina was lined by a thick (about 1 centimeter) loose tissue which could be separated from the wall with the fingers. The cervix was hard, nodular, irregular, closed and pointed down and forward. The corpus was firm, retroverted to the second degree, not definitely enlarged and free. The adnexa were not palpable, and the formices were not tender. The examining fingers were covered with a foul, serosanguineous discharge.

Speculum examination showed a greenish, gray, thick (1 centimeter) membrane lining the vagina. On removing this membrane with a forceps, bleeding points were left.

Direct smears and cultures were made from the vagina and a block of the membrane was taken for section. A throat culture was also made.

Laboratory reports: Blood count on September 27, 1924 showed: hæmoglobin, 80 per cent; white blood cells, 10,000. Urinalysis was negative. Direct smears showed many streptococci and staphylococci. Cultures from vagina and throat were positive for Klebs-Loeffler bacillus. Microscopic section of the membrane showed fibrinous material containing many red blood cells and bordered by a heavy layer of white blood cells.

When the diagnosis was made, 15,000 units of diphtheria antitoxin were given intramuscularly. The patient felt better generally except for weakness. On the third day in the hospital she became temperature-free and remained so except for slight rises up to 99.8 degrees throughout her stay of 14 days. On the twelfth, thirteenth, and fourteenth day cultures from the throat and vagina were negative for Klebs-Loeffler bacillus; therefore the patient was allowed to go home.

The second case is a diphtheritic vulvovaginitis:

Mrs. M. P., No. 869564, a primiparous white woman, 33 years old, entered Ward 51 of Cook County Hospital on December 29, 1923, on Dr. Lee's service. She was in labor, the first stage being 11 hours long, the second stage 1 hour, 33 minutes, and the third stage 7 minutes, delivering spontaneously a full term normal male child on December 30, 1923, suffering a small second degree tear which was not repaired.

On January 1, 1924, she developed a temperature of 102.4 degrees, pulse 72, and complained of pains

in the abdomen. Examination revealed tenderness and resistance over the left lower quadrant, and the uterus firmly contracted. The following day her temperature varied from 99.6 degrees F. to 100.8 degrees F. A suspicious membrane was noted on the labia on January 3, 1924; a smear revealed diphtheria-like bacilli. A culture grew Klebs-Loeffler's bacilli; therefore, 10,000 units of diphtheria antitoxin were given. The condition remained the same, so 15,000 units more of diphtheria antitoxin were given. A serum reaction resulted, joint pains, general malaise and slight urticarial eruption about site of injection. A profuse, foul, purulent vaginal discharge was observed on January 22, 1924, in addition to the thin gray membrane. A virulence test was done on February 2, 1924, but the guinea pig was unaffected. As her general condition was good, her temperature normal, local findings cleared up, and culture negative, patient was discharged on February 3, 1924.

CONCLUSIONS

1. Diphtheritic vaginitis is uncommon as reported in the literature. At Cook County Hospital only one case of postpartum diphtheritic vulvovaginitis was observed in approximately 7,500 deliveries.

2. It is more common in children although a case has been reported in a woman 55 years old. Secondary infection of the vagina from throat diphtheria is more common than primary infection of the generative organs.

3. The mortality is high because of the late recognition of the condition due to infrequent vaginal examinations. When recognized the condition must be treated by fairly large doses of antitoxins. Also precautions must be instituted to prevent secondary infections of the other mucous membranes.

4. The present cases were diagnosed because in the first case a vaginal examination was made which was accompanied by bacteriological examination. The membrane was visible in the second case and cultures were studied.

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DEPARTMENT OF TECHNIQUE

A METHOD FOR AN END-TO-END GASTROJEJUNOSTOMY AFTER A PARTIAL GASTRECTOMY

By T. S. MOISE, M.D., and S. C. HARVEY, M.D., F.A.C.S., New Haven, Connecticut
From the Department of Surgery, Yale University, School of Medicine

THE problem of the choice of procedure after partial gastrectomy is one of great interest and importance and its solution depends on the mechanical efficiency of the end-result. It is generally conceded that an end-to-end anastomosis is mechanically and physiologically more ideal than any other procedure. The frequently used Pólya type of anastomosis is in reality an end-to-side anastomosis and has the disadvantage of severing the circular muscle fibers of the jejunum throughout the entire length of the stoma. This interferes with the peristaltic activity at the site of the anastomosis with the formation of an atonic area which frequently dilates with a resulting pouch. These objectionable features suggest the probable superiority of a different type of anastomosis without a longitudinal incision into the jejunum and accordingly with minimal injury to the muscle fibers of the circular coat. This can be done quite readily by incising the jejunum transversely and in effect performing an end-to-end anastomosis.

The object of this communication is to outline the operative procedure and to report briefly the results of an experimental study of this type of anastomosis.

OPERATIVE PROCEDURE

The operation is performed in the following manner: After a partial gastrectomy has been completed, the jejunum is lifted into place for an antecolic anastomosis. Two small crushing clamps are applied to the jejunum at the site selected for the anastomosis (Fig. 1). These clamps are placed side by side, extending transversely across two-thirds of the diameter of the intestine. An incision is made between the clamps and their handles are allowed to separate (Fig. 2).

This portion of the jejunum is then united to the cut end of the stomach by a row of interrupted silk sutures forming the posterior suture line (Fig. 3). Small intestinal clamps are placed on the proximal and distal loops of intestine. The crushing clamps are removed and the crushed edges of the jejunum are excised.

The open ends of the stomach and the jejunum are then united in the following manner: A continuous through-and-through catgut suture is inserted, beginning in the middle of the anastomosis posteriorly, and is carried in either direction (Fig. 4). This suture is continued around either angle

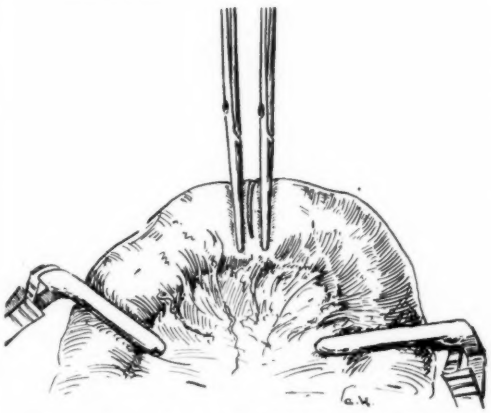

Fig. 1. The crushing clamps have been applied to the jejunum and an incision has been made across two-thirds of the diameter of the intestine.

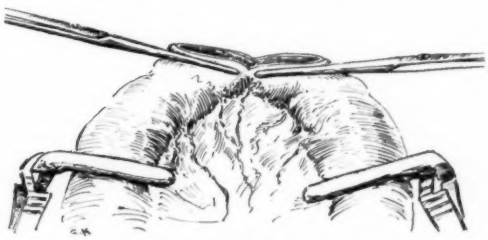

Fig. 2. The crushing clamps have been separated showing the opening into the jejunum at the site which is to be anastomosed.

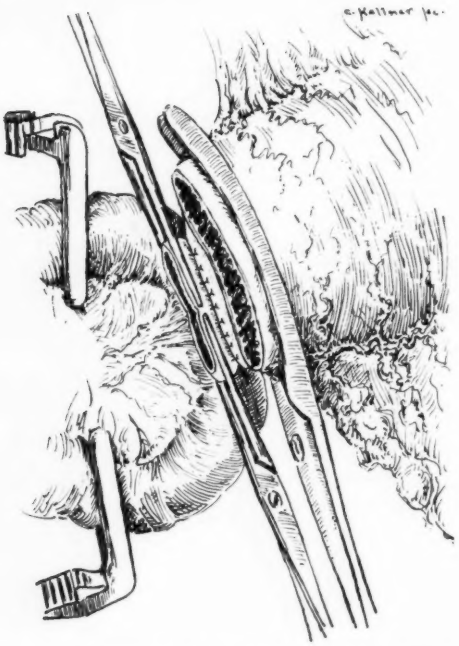

Fig. 3. The stomach and the jejunum have been approximated and the posterior row of interrupted silk sutures has been completed.

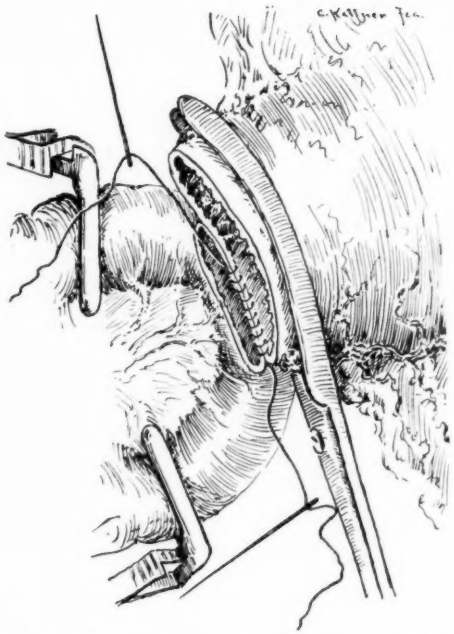

Fig. 4. The crushed edges of the jejunal opening have been excised after removal of the clamps. The continuous inner suture of catgut across the posterior half of the stoma has been partly completed.

as Connell's continuous inverting, as below mattress stitch (Fig. 5). The stomach end is not puckered but the excess portion is closed in the usual manner. Finally, a continuous Lembert suture of fine silk is inserted to reinforce the anterior layer (Fig. 6).

DISCUSSION

This operation has been performed successfully on a small series of dogs. In performing this operation on the dog the placing of the sutures must be done with meticulous care, as a large diaphragm will encroach on and partially or even completely occlude the intestine.

The functional result has been good and the animals have thrived. The condition of the stoma has been determined by barium X-ray studies and by postmortem examinations of the specimens (Fig. 7). The barium studies have shown that the meal passes through the opening slowly and freely but that the stomach is not precipitately emptied.

The animals were anæsthetized so that the specimens could be examined *in situ* before removal, and active peristalsis was observed upon stimulation of the stomach. On removal, the specimens showed a patent lumen of the size of a cross section of the jejunum (Fig. 8).

The procedure described above is an end-to-end anastomosis, the underlying principles of which are those which govern all intestinal surgery.

In contrast with the usual procedures used after a partial gastrectomy which are end-to-side or side-to-side methods, this procedure is an end-to-end anastomosis and should have the mechanical and physiological advantages that are inherent in the end-to-end anastomosis.

In contrast with the Polya type of gastrojejunostomy, one avoids cutting the circular muscle fibers over a wide area, and there is no opportunity for the formation of an atonic dilated pouch at the site of the stoma.

After this operation is completed the two loops of jejunum naturally gravitate downward, which is the optimum position for the maintenance of a patent stoma, while this same tendency for the loops to drop down after the Pólya anastomosis may tend to kink and partly occlude the opening.

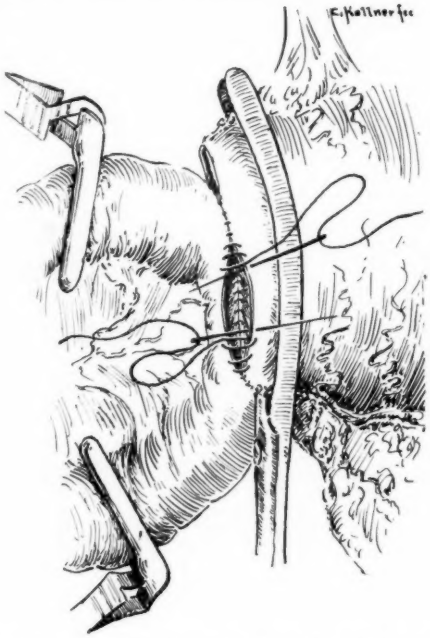

Fig. 5. The suture, shown in Figure 4, has been continued around either angle. This is Connell's continuous, inverting, mattress stitch.

Fig. 6. The operation has been completed. The drawing was made of a specimen *in situ* after complete healing. The outer continuous silk suture has been completely obscured during healing.

Fig. 7. A photograph of a specimen (Dog No. 33) 4 weeks after operation showing the appearance of the healed anastomosis.

Fig. 8. A photograph of a specimen (Dog No. 33) 4 weeks after operation showing the line of the anastomosis, from within. The proximal loop of jejunum is shorter than the distal one.

The size of the stoma is that of the cross section of the jejunum which obviously is the maximum possible size of the effective lumen in any type of anastomosis, even though other proce-

dures with a longitudinal incision into the intestine give a seemingly larger opening.

This operation is an experimental method, and it is advisable in transferring the procedure from the laboratory to the clinic also to perform a side-to-side anastomosis between the ascending and descending portions of the jejunum to prevent any possible stasis in the proximal loop.

USEFUL MECHANICAL AIDS IN THE TREATMENT OF FRACTURES OF THE SPINE

By FREDERICK CHRISTOPHER, M.D., F.A.C.S., Winnetka, Illinois
Junior Surgeon, Evanston Hospital; Assistant Surgeon, St. Luke's Hospital, Chicago, Illinois; Assistant in Surgery, University of Illinois Medical School

THE care of fractures of the spine may be subdivided into two great departments. The first deals with the collection of accurate neurological, X-ray, and other evidence which will enable one to make the important decision of whether or not to operate, when to operate, and should operative measures be decided upon, what they should be. The second deals with the extended and involved campaign of the convalescent care.

The first field is a tempting one for discussion and one in which there is still much controversial material (1, 2). I believe that the keynote to a correct understanding of the surgical indications is the report of the best neurologist available. Cases with deformities as shown by X-ray and with incomplete cord lesions do not require laminectomy when the maximum disability has occurred concurrently with the injury and when the neurological evidence shows that the cord involvement is diffuse in the section involved. Such lesions are those which might be expected in contusions or concussions of the cord. On the other hand when the neurological evidence points to hæmatomyelia or pressure external to the cord, bony or otherwise, operative measures are, of course, indicated. Spinal puncture should not be done in those cases requiring lordosis for optimum reduction of the vertebræ unless the indication is very clear cut, as for example when it becomes necessary to see if the spinal fluid is of the character of non-circulating fluid below a compression. Should relief of pressure be desired laminectomy is preferable.

Fig. 1.

Fig. 2.

Fig. 1. Roentgenogram showing compression fracture of the first lumbar vertebra with backward displacement.

Fig 2. Anteroposterior roentgenogram showing compression fracture of the first lumbar vertebra.

This contribution, however, deals with the second department of the care of fractured spines and is designed to suggest certain mechanical aids which proved of benefit in a case of paraplegia not operated upon.

The essential requirements of a good mechanical apparatus are that: (1) it shall maintain the fracture in the optimum position; (2) it shall be comfortable to the patient; (3) it shall facilitate the care of the skin, particularly of the buttocks; (4) it shall make the painstaking attention to the

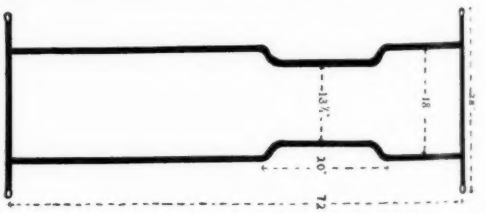

Fig. 3. Diagram of modified Bradford frame. Note rings for the attachment of snap hooks at the four corners of the frame.

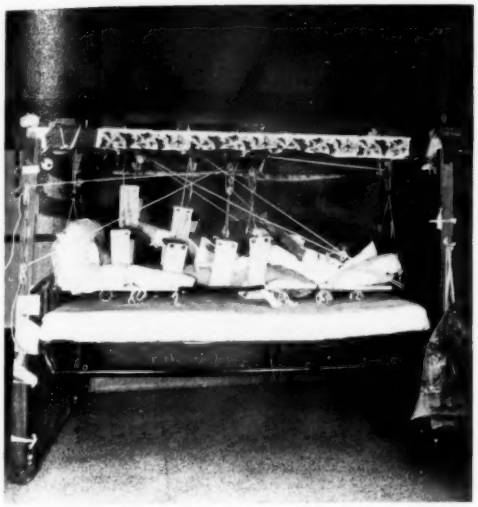

Fig. 4. Apparatus to facilitate care of fracture of spine. Patient rests on modified Bradford frame in lordosis. She is giving her hip and knee joints passive motion. Note adjustable and removable bands under buttocks.

hygiene of the lower bowel easily possible by one nurse; (5) it shall include devices for the maintenance of joint function; (6) it shall provide against foot-drop; (7) it shall permit the ready transference of the patient from his bed to sun parlor, roof gardens, etc.

Numerous devices have been found to be useful. Wallace (3) has devised an ingenious elevating frame which lifts the patient's body above the level of the bed and brings about lordosis. Kirchner (4) employs a trapeze in which the patient may sit in the later stages of his convalescence while a wheel chair is rolled under him.

The following case report details the methods I have used in the treatment.

Patient, B. W., age 12, fell some 20 feet from a tree house on June 3, 1924. She apparently struck the ground on her buttocks and sustained a very forcible flexion of the spine. She was carefully transported to the Evanston Hospital where she was first seen by the writer. Cursory examination showed complete paralysis of both legs with maintenance of sensation and hyperæsthesia over both hips. X-ray examination showed a compression fracture of the first lumbar vertebra, the body of which was displaced backward for about ¼ inch (Figs. 1 and 2.) There was apparently no displacement of the alignment of the spinous processes which indicated that there was a fracture of the laminæ.

The patient was seen at various times in consultation by Drs. John L. Porter, Lewis J. Pollock, Ralph C. Hamill, and Alfred W. Adson. The report of Dr. Pollock's examination is as follows:

"Paralysis of both lower extremities which is flaccid in character with no spasm or contractures. The patient can contract the external hamstring on the right and the internal and external hamstring on the left, but is not able to contract the extensors of the thighs. No Beevor's sign.

Deep reflexes. Achilles and knee jerks absent. Recti jerks normal.

Superficial reflexes. Right Babinski. Left Babinski and marked withdrawal movement in flexors of legs, thigh and foot. Abdominals absent.

Sensation. Hyperæsthesia over second, third, fourth, and fifth lumbar vertebræ. Touch was very slightly diminished over the anterior tibials. Pain, hyperalgesia on right at level of second lumbar vertebra with preservation of sensation over second, third, fourth, and fifth sacral vertebræ; on left at upper level of second and third lumbar vertebræ and preservation of one part of the second, third, fourth, and fifth sacral vertebræ. *Temperature sense* was diminished over the same areas. *Vibration sense* was lost on the right below the anterosuperior spine and only over the tibia, fibula, and foot on the left. *Joint sense* was lost in right great toe.

Vegetative system. There was involuntary urination which, however, is recognized; and retention of fæces.

Diagnosis. Intramedullary lesion, probably concussion, not due to bony compression.

Prognosis. Fair to good."

Fig. 5. Showing the easy position of windlass which elevates and lowers patient and Bradford frame.

The patient was placed on a modified Bradford frame. This frame (Fig. 3) was 72 inches long and was 18 inches wide, save for the section which extended from the axilla to the iliac crests where it was narrowed to 13½ inches which was the width necessary so that the lateral bars were close beside the patient's body. The wider part at the shoulders made possible a more comfortable arrangement of the pillows while the lower wide part gave better access for care of the buttocks and facilitated the giving of enemata. The patient was supported on the frame by the customary broad canvas bands which were made tight by lacing on the under side (the ends of the lacing tapes may be seen in Fig. 4). To give the degree of lordosis desired a broad felt pad was placed under the injured (first lumbar) vertebra.

At the four corners of the frame were rings to which snap hooks were attached. The latter were connected to a ring from which strong rope was led over a windlass, the axis of which paralleled the long axis of the bed. The bearings of the windlass were attached to transverse

Fig. 6. Frame placed on blocks on stretcher and patient enjoying sunbath on roof of hospital.

wooden pieces which in turn were made fast to the top of the Balkan frame (Fig. 5). The windlass was readily wound up by turning the cross bars at the lower end. In this case, although the nurse weighed 3 pounds less than the patient, she easily lifted the latter, frame and all, to any desired height above the bed. The frame generally was suspended 3 or 4 inches off the bed all the time and held in position by a rope from an arm of the windlass to a cleat on the Balkan frame (see nurse's left hand Fig. 5). With the Bradford frame at this height the bed pan was readily placed under the buttocks for the giving of enemata or the collection of urine when voided involuntarily.

Under the buttocks were placed two strong canvas bands each 4 inches wide. On the ends of these were grommet holes which could be instantly slipped over screw heads which protruded from the ends of stout wooden spreaders. The latter were supported by blocks and tackles, the rope of which was made fast to cleats at the bedside (Figs. 4 and 5).

This contrivance is of great value. When an enema is given or when the skin of the urine-soaked buttocks is to be washed, dried and powdered, the footward band is removed and these operations are readily carried out. This band is then replaced and the headward band is removed and the skin beneath it is cared for. In between times the patient is supported on both bands which are adjusted for proper lordosis and comfort.

As is well known the joints will become stiff and painful unless the extremities are subjected to passive motion. The patient will be seen giving herself passive motion in Figure 4. This she does by manipulation of ropes which elevate bands passed under the knee and ankle. Passive motion is not infrequently better carried out by the patient than by the attendant and in this case it was certainly true for the patient enthusiastically entered into the program and both knee and hip joints were kept in freely movable condition.

Two methods of preventing foot drop were employed, one to support the feet on pillows as shown in Figure 4 and the other by traction over pulleys which may be seen at the head of the bed. A trapeze was of great comfort though the patient was not permitted to raise her shoulders.

The elevated position of the frame added greatly to the patient's comfort in hot weather as the air came into contact with greater areas of skin. The child's interest was aided by decorating the frame, the addition of dolls, etc.

Another feature of great importance was the ease of moving the patient. To accomplish this a broad band was laced to the Bradford frame under the two buttock bands. The latter were then disconnected as well as the gear for passive joint motion. The frame was lowered to the bed and the snap hooks detached from the corner rings. The Bradford frame was then easily lifted and placed on two wide blocks which rested on the top of a stretcher.

The child's happiness was greatly increased by her trips on this stretcher. Many hours were spent on the roof (Fig. 6) enjoying the sunshine and lake breeze.

Rectal control (which had never been completely lost) and bladder control were back to normal

after about the first 10 days. A month after the accident the patient was able to lift her left knee 3 inches and her right knee 1 inch off the bed, had adduction and abduction control of the thighs, and was able to move both great toes and feet slightly. Continual progress is being made and the prognosis is felt to be very encouraging.

At this stage of the convalescence the patient was occasionally lowered into the posterior half of a well padded plaster cast, and, while resting in this, was placed in a wheel chair.

On March 1, 1925, which is 8 months after the injury, the patient is able to walk 50 feet unaided. She is fitted with a spine brace and is continuously treated by massage and selected exercise. She has returned to school and is in robust general health.

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A NEW FORM OF LIGATURE NEEDLE

BY H. S. SOUTTAR, F.R.C.S., LONDON, ENGLAND

EVERY surgeon must have experienced the difficulty of keeping separate the two portions of a ligature passed on an aneurism needle when tying off omentum and similar structures. In fact many surgeons prefer to pass the aneurism needle twice in order to avoid confusion; but even so the ligatures may be so close together that it is a difficult matter to cut with safety between them.

On a visit to Switzerland I was very much struck by the way in which Kocher's blunt dissector is there universally used to overcome these difficulties. The classical instrument has three grooves, and after it has been passed a ligature is carried down each of the lateral grooves by an aneurism needle and is tied. The pedicle is then divided by means of a pair of scissors guided by the central groove.

It occurred to me that a good deal of time might be saved if the use of the aneurism needle could be altogether avoided. I therefore divised the instrument illustrated.[1] It has a broad blade with one deep groove, and across the end a transverse hole through which the ligature is passed. The two ends of the ligature can be kept entirely separate as the threaded needle is passed through the omentum. An assistant cuts the ligature and ties one side, while the surgeon ties the other and cuts the omentum between.

The breadth of the instrument might at first sight appear clumsy, but as a matter of fact it enables the operation to be carried through with a neatness and dexterity impossible with the ordinary methods. The tissues are not torn but are gently spread apart, with the result that the whole proceeding is carried out in full view, while an adequate stump insures a remarkable security for the ligatures.

I have now been using the instrument for nearly a year and I am very much taken with its convenience. In such operations as gastrectomy and colectomy the saving of time and the added clearness of operative technique are quite remarkable.

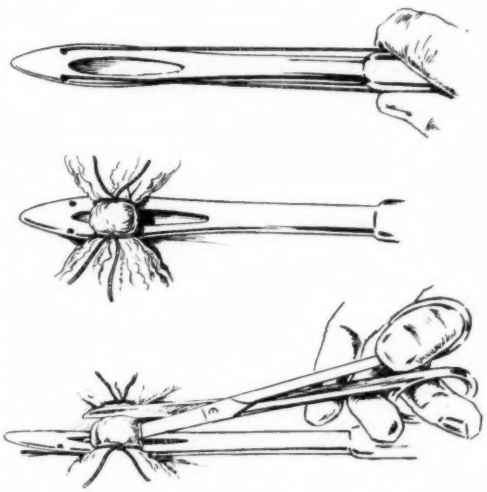


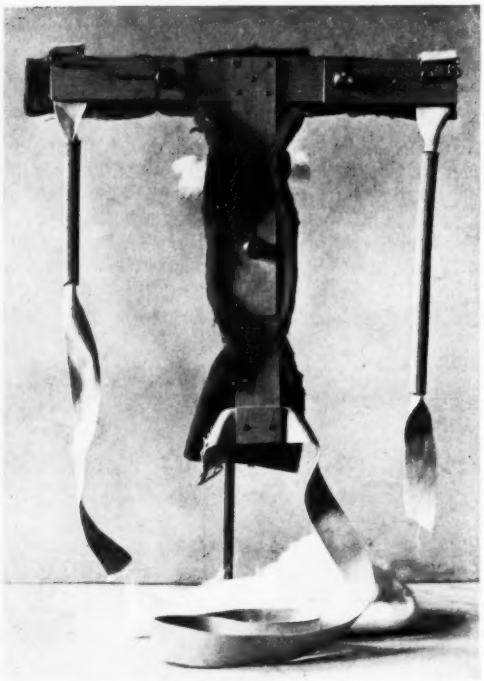
Fig. 1. Drawing showing the new ligature needle.

[1] Made for me by Messrs. Allen and Hanburys.

A MODIFICATION OF THE CLAVICULAR CROSS

By BENEDICT B. LANDRY, M.D., Hartford, Connecticut

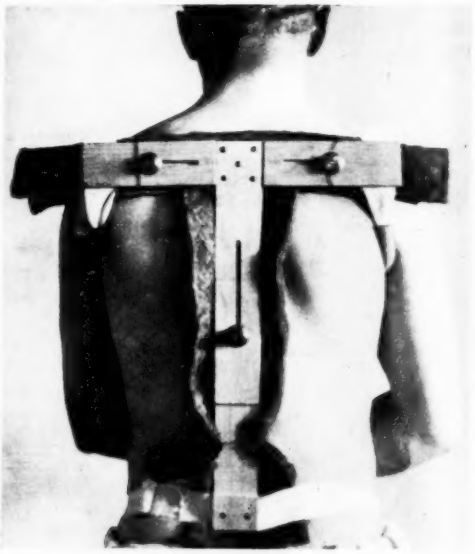
THE use of the clavicular cross in the management of fractures of the clavicle, especially of the outer and middle thirds, has been quite common and the results of this usage are uniformly satisfactory. A convenient modification of this cross has been made in the form of an adjustable cross which will be found applicable in the treatment of clavicular



fractures by the so-called "crucifixion" method. It can be readily adjusted to patients of all sizes.

The pictures explain the essentials of the splint. It consists of five pieces of seasoned maple, the cross piece and spinal piece being joined at right angles by five small screws. For convenience in transportation these may be removed and the parts placed in opposition. In the longitudinal axis of each arm of the cross there is a slotted portion which allows this piece to be moved along a screw bar. This piece is held in the position desired by tightening the screw which is fixed to the cross piece. The screw for adjusting the spinal piece is fastened to the movable part. By means of this screw the splint can be adjusted to the shoulders and the sacral promontory.

A small square block is held at the end of each movable portion by two screws which also hold the webbing firmly.



The padding and the rubber tubing which is placed over the webbing to prevent chafing differ in no way from those of the unadjustable clavicular cross.

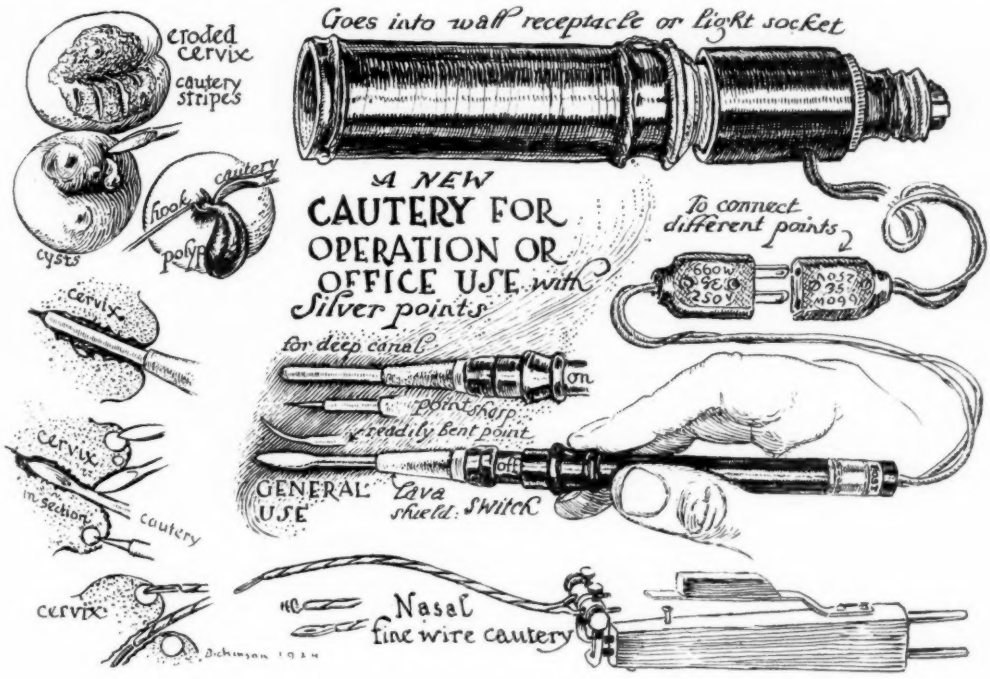
A SIMPLE SILVER POINT CAUTERY

By ROBERT L. DICKINSON, M.D. F.A.C.S., New York

A PROMISING and convenient outfit which has been subjected to a moderate number of tests covering several months calls for general trial because of its simplicity and low cost. For operating room cautery work, as for removal of piles or appendix, and for easy cases of cancer excision it appears to meet the need. For office gynecology it is fairly effective.

The device consists of a controller that fits into any ordinary wall receptacle or light socket and a handle (with a make-and-break switch) which bears a silver cautery tip or point within which is a tiny heating element. Various forms of point are supplied, but each is fast to its own handle. The most generally useful is the spear point shown in the illustration as the lowest of the tips and there labeled "general use." As the spear end is solid it may be bent, as when circumventing a polyp to get at its stalk. There is a cylindrical tip for cooking the entire lining of the cervix, and a spike tip for opening Nabothian cysts, if desired. Practically the spear can do all these. The only drawback found was that the heating is general and is not accentuated most strongly at the very tip, as with platinum electric points. The all-round availability and the low cost (twenty-five dollars for outfit with single point, twelve dollars and a half for each additional handle and its point) makes the instrument a marked step forward. For delicacy it cannot yet compare with the platinum electrodes of the nasal cautery that can cook the minute channel of a urethral gland or reach high in the cervical canal for the stalk of a polyp. (See lower edge of drawing.) The total outfit for this nasal cautery for use with the alternating current costs eighty-five dollars, for the direct current, thirty-five dollars. (In New York, for instance, Manhattan has direct current, the Bronx alternating current, and Brooklyn has both in all sections.)

The sketches show also the use of the cautery in chronic endotrachelitis. A granular, eroded,



everted cervix in a patient not fit for operation can be healed by a couple of office treatments by fine cautery stripes at a 3 week interval; cysts thus opened gape until they are cured; polyps have their bases properly cooked; and no treatment of our everlasting gonorrhœal cervical catarrhs compares with this delicate office adaptation of Hunner's[1] clumsy Paquelin cautery operation.

[1] G. L. Hunner. Endotrachelitis. J. Am. M. Ass., 1906, Jan. 20.

This cervix work comprises no small part of office gynecology, as cervical catarrhs are the chief source of sterility and leucorrhœa, raw cervices call for healing between babies, and many eversions may be inrolled and escape operation. The results have already been pictured in the *American Journal of Obstetrics and Gynecology*, December, 1921. Since that publication the treatment has received wide endorsement.

CHRONIC ENDOCERVICITIS; ITS CLINICAL IMPORTANCE AND RESULTS FROM TREATMENT WITH THE ELECTRIC CAUTERY[1]

By CARL HENRY DAVIS, M.D., F.A.C.S., Milwaukee, Wisconsin

ENDOCERVICITIS as a clinical entity was not recognized until bacteriological studies demonstrated that the endometrium of the uterus is usually free from bacteria. Winter, in 1888, made the first contribution, and 7 years later, Stroganoff and Menge, working independently demonstrated that bacteria are not normally found above the external os. Arthur Curtis, in 1918, confirmed Winter's observations regarding the endometrium and demonstrated the susceptibility of the cervical glands to chronic infection.

Since the pioneer work of Billings and Rosenow establishing the possible dangers from chronic foci of infection, the need for eliminating chronic infection from the cervix uteri is gradually becoming appreciated. The experimental work of Laura Moench should lead to increased efforts. She has demonstrated, in Rosenow's laboratory at the Mayo Clinic, that organisms grown from the chronically infected cervical glands of patients suffering from arthritis will produce joint lesions in rabbits. Culturally these organisms are identical with the anaerobic streptococci commonly found in other foci of infection in patients suffering from arthritis. Her results from bacteriological and experimental studies again suggests Sturmdorf's likening of the cervix to the tonsil and should definitely establish it as one of the important locations for foci of chronic infection.

Chronic endocervicitis is always due to the presence of bacteria even though trauma, mechanical or chemical, has acted as a predisposing cause. The trauma may have resulted in one or more of many ways such as lacerations from childbirth, irritation of a stem pessary, the use of a wish-bone pessary as a contraceptive, dilatation and curettage, masturbation, attempts at abortion, intracervical treatment of gonorrhœa, strong chemicals in touches, etc. Kept free from bacteria the trauma would heal rapidly in most cases, but the cervical mucosa with its racemose glands once invaded tends to harbor the bacteria and there results a chronic inflammation, involving first the glands and eventually the deeper structures producing a chronic cervicitis as well as endocervicitis. Its importance depends on the virulence of the invading organisms and the associated pathology as well as the symptoms produced.

A speculum examination, which should always be made as an essential part of a careful pelvic examination, frequently reveals an endocervicitis with some degree of erosion in patients who report little or no trouble from leucorrhœa. The history usually shows one or more of the following complaints: dysmenorrhœa, sterility, pelvic pain, dyspareunia, backache, menorrhagia or metrorrhagia, nervousness, or debility. The endocervicitis must be treated in attempts to relieve sterility. Dyspareunia results from the tenderness due to secondary inflammation in the tissues along the lymphatics which drain the cervix. In subacute cases there is usually some thickening and tenderness of the uterosacral ligaments, and frequently there is a perisalpingitis and perimetritis. Too active treatment during the acute stage of endocervicitis may result in an acute pelvic involvement. Failure to diagnose and treat endocervicitis during pregnancy definitely increases the risk of puerperal sepsis.

That cancer of the cervix is more apt to develop in women with chronic cervicitis, and endocervicitis is generally accepted even though the factors which cause the malignant change are not understood. A differential diagnosis between early car-

[1] Read before the Chicago Gynecological Society, December 19, 1924. (For discussion, see p. 585)

cinoma and chronic endocervicitis may be impossible in the examining room. A microscopical examination of the involved tissue is indicated in all doubtful cases. Tissue may be removed with a nasal or tonsil punch and the area immediately cauterized with a nasal type cautery. The possibility of syphilis must always be kept in mind. While syphilitic lesions differ from those of endocervicitis with erosion, it is evident that they are rarely recognized. A dark field examination or biopsy should be made when in doubt.

The recognition that chronic endocervicitis is a menace to the future health of the patient has led to renewed efforts to secure an effective cure. Thus far very little has been accomplished in the way of prophylactic treatment. With the exception of infections due to the gonococcus and possibly those resulting from attempted abortion it is probable that most endocervicitis develops insidiously without an acute stage. Nevertheless it must always be remembered that the types of treatment which are most effective in eliminating a chronic endocervicitis may result in serious complications if used during the acute or subacute stage of the infection.

Local applications with silver nitrate, tincture iodine, zinc sulphate, phenol, etc., have undoubtedly been useful in certain cases when combined with icthyolglycerine tampons and douches, but the results have more often been unsatisfactory. A high amputation of the cervix removes the diseased tissues but this operation is to be avoided if possible during the childbearing period. Low amputation of the cervix and trachelorrhapy are both useful in cases with ectropion following laceration of the cervix during childbirth, yet the end-results are often unsatisfactory and additional treatment is frequently required.

Sturmdorf in perfecting the conical excision of the cervical glands made a real contribution to the surgery of the cervix. This type of operation does not destroy the muscular portion of the cervix, and therefore leaves a fair protection to the cavity of the uterus. Technically it is more difficult than an amputation but the end-results are superior. Matthews gives an excellent illustrated description of this operation and the results obtained at the Long Island College Hospital. A follow-up of 200 patients treated from 6 months to 3 years prior to the study showed 128, or 64 per cent, were cured; 56, or 28 per cent, were improved; and 16, or 8 per cent, were unimproved. These results are compared with Leonard's report of amputation of the cervix in 109 cases with marked leucorrhœa from Kelly's clinic at the Johns Hopkins Hospital in which 62.5 per cent were cured, 30 per cent were improved, and 7.5 per cent were not improved.

The use of radium in the treatment of chronic endocervicitis was first reported by Arthur Curtis in 1920. The results in the first 46 cases were so much more satisfactory than he had obtained with previous methods that he continued this type of treatment for the more severe and obstinate cases and in 1923 reported a total of 126 patients treated with radium. Of the 104 patients available for careful follow-up he found that 90 had recovered, 7 were improved, and 7 had not been benefited. This report shows that better results may be obtained from radium than have thus far been secured by the older operative and medical methods of treatment. But the action of radium cannot be limited to the destruction of the cervical glands and there is a scar tissue formation in the muscular tissue which tends to contract and cause a stenosis of the cervix. This not only necessitates dilatation subsequent to the treatment but it may interfere with subsequent pregnancy and labor. At times the secretion which persists after the destruction of the cervical glands with radium is very irritating and may be as annoying as the leucorrhœa from which the patient previously suffered.

Multiple scarification of the cervix which has been used by another member of our society, Henry T. Byford, requires a long period of office treatment. It depends on a combination of multiple puncture of the cystic area and the use of iodized phenol to sterilize and destroy the diseased tissue. In his report made in 1921, Dr. Byford made no mention of the end-results.

The cautery knife was used by Byrne in treating cancer of the cervix as early as 1892 and during the years following the cautery was used from time to time in the treatment of cervical disease. The type of healing which was observed after extensive cauterization suggested to Hunner the advisability of using the Paquelin cautery in the treatment of endocervicitis. His first report was made in 1906. Dickinson began the use of the nasal cautery tip in the office treatment of endocervicitis in 1911, and reported his satisfaction with this procedure in 1921. Following this report I began a cautious test of the nasal type cautery in the office, and at first with rather poor results. Later with a better transformer and increasing experience the results improved and confidence in the method was established. This method causes very slight pain. Most patients are more frightened than hurt and it is important to eliminate the noise of the rotary transformer, if one is required, by placing it in another room.

The technique in our office is as follows: After inserting a suitable bivalve speculum the mucus discharge is thoroughly removed with cotton balls. A suitable nasal cautery tip, preferably one longer than usually supplied, is placed firmly against the tissue to be destroyed and the current turned on. As a sufficient depth is reached the tip is gradually moved so as to make a line through the diseased tissue. In many cases it is only necessary to cauterize the glands near the external os, in others the disease extends to the internal os. If at any time the patient complains of discomfort the contact button is immediately released and the current not applied again until she is comfortable. This process is repeated until a sufficient number of cautery lines have been made. Nabothian cysts are destroyed in a similar manner after puncturing with the heated tip. An effort is made to reach the depths of the glands so as to destroy the chronically diseased tissue.

Most cases of endocervicitis may be treated in the office. One thorough cauterization results in early relief from most of the symptoms and complete healing usually is found after 6 to 8 weeks. If the first treatment is superficial a second may be indicated after 4 weeks. Very few patients will need more than two treatments with the cautery. During the past year only one patient out of 102 treated by my associate Dr. Cron and myself has had as many as three cauterizations. As a rule it is advisable to administer an anæsthetic (gas and oxygen) to virgins, women who are very nervous or those who require unusually deep cauterization due to the long duration of the endocervicitis. It may be difficult at times to remove tissue for examination unless the patient has an anæsthetic.

After a cautery treatment the patient is instructed to wear a pad until the increased discharge stops which is usually in about 10 days or 2 weeks. She is also warned that the next period may be more profuse than normal. One patient cauterized extensively under anæsthesia for an old cystic condition of the cervix bled so profusely with the next period that a pack was inserted for a few hours. Several others have had to remain in bed for one or more days owing to the excessive flow. The patient is instructed to keep herself clean by external washing. Douches are of questionable value and as a rule women are advised against their use. It has been our custom to paint the cervix with a 5 per cent mercurochrome solution every week or 10 days until healing is complete. However, the observation that out of town patients, who do not return for a month or 6 weeks after the treatment, heal as quickly makes it seem that this extra medical care may not be necessary, although advisable as a means of following the case. Sex trauma should be avoided until healing is complete.

One-hundred and fifty-five patients with endocervicitis have been treated by other than local applications and tampons since the nasal type cautery tip was first used in our office. Eighteen patients were treated surgically, the cervix being repaired or amputated as a part of the operative procedure.

To December 15, 1924, cautery treatment has been used as an office procedure on 106 patients, and 31 have been cauterized under anæsthesia at the hospital. With the exception of those treated within the past few weeks and still under observation, healing has occurred in most instances within about six weeks and the results have been very satisfactory. Every patient has been improved. Two patients still have some trouble with leucorrhœa, although it is much reduced in amount and not constant. Among the symptoms relieved are dysmenorrhœa, dyspareunia, pelvic tenderness and pain, backache, menorrhagia, metrorrhagia, and sterility.

Medical diathermy as used by Corbus may be effective in killing the gonococcus but it has not been tried in other infections. In our office it has been of very little value in treating chronic endocervicitis. Electric coagulation seems to be superior to the cautery in treating inoperable cancer of the cervix, but we prefer the light cautery tip in destroying erosions and the chronically diseased cervical glands.

Mercurochrome in 3 to 5 per cent solutions has been found a very useful germicide for the treatment of acute and subacute conditions and as an adjunct to the cautery in chronic endocervicitis. It is used by us in the preparation for vaginal operations.

Women approaching or past the menopause are more liable to cervical cancer, and radical treatment may be indicated. Total hysterectomy sometimes is a conservative procedure provided the patient is a good surgical risk.

SUMMARY AND CONCLUSIONS

1. Chronic endocervicitis is a common condition, usually neglected and frequently responsible for other pelvic diseases such as perisalpingitis and perimetritis.

2. Its presence increases the possibility of cervical cancer.

3. It is directly or indirectly responsible for much of the sterility in women.

4. Chronic endocervicitis must be considered in treating arthritis in women. Once infected the racemose glands of the cervix are prone to harbor the organisms for an indefinite period, and if the bacteria are of a virulent strain the secondary results may be disastrous.

5. Every pelvic examination should include an inspection of the cervix. A diseased condition of it should be diagnosed and treated.

6. Chronic endocervicitis due to a virulent organism is the probable cause of certain cases of puerperal sepsis and postoperative peritonitis.

7. The types of treatment which are effective for the chronic condition may cause serious complications if used during the acute or subacute stage of the infection. A 3 to 5 per cent solution of mercurochrome may be applied locally during pregnancy and the puerperium as well as for the acute conditions in other women.

8. In 155 consecutive cases of endocervicitis treated by other than local applications, 18 had a cervical operation, 31 were cauterized under anæsthesia at the hospital and 106 without anæsthetic at the office. The condition has been improved in every case and healing has occurred usually in about 6 weeks. A few patients require subsequent cauterization. In two cases the cervical leucorrhœa while improved is not entirely relieved.

9. Among the symptoms relieved are dysmenorrhœa, dyspareunia, pelvic tenderness and pain, backache, menorrhagia, metrorrhagia, and sterility. Cautery treatment is usually contraindicated during pregnancy, but may be used for superficial polypoid areas which bleed. Stricture of the cervix has not followed treatment in any of our cases. Two patients who had extensive cauterization under anæsthesia have been delivered without difficulty.

10. Our observations suggest that the infection and resulting changes are limited at first to the glands near the external os. This is especially true in erosions developing during the puerperium. A single superficial cautery treatment about 8 weeks after delivery usually results in prompt healing within about 3 weeks. This, more or less, prophylactic measure should prevent most of the severe chronic conditions of the cervix which tend to develop after childbirth.

11. The type of treatment must be varied according to the extent of the lesion, the age of the patient, the nature of the infection, and the associated pathology. In most cases the chronically infected tissue must be surgically removed, or destroyed through the use of radium or electric cautery. It is believed that electric cauterization with a light cautery tip is the method of choice in most cases which have no other indication for surgery.

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THE TREATMENT OF CHRONIC GONORRHŒA IN WOMEN WITH THE ELECTRIC CAUTERY[1]

By H. W. SHUTTER, M.D., Milwaukee, Wisconsin

THE application of the electric cautery to the treatment of gonorrhœa in the female offers two distinct advantages over the older, more haphazard methods. First, it provides a means of curing the irresponsible patient who will not cooperate in her own treatment; second, it affords the physician a method of curing the conscientious sufferer. Specialists have recognized for many years that the infection, though general in its acute stage, localizes itself by the time active intervention is indicated in three gland structures of the lower genito-urinary system; the cervix, glands of Bartholin, and the para-urethral glands of Skene. In the adult, vulvitis, vaginitis and generalized urethritis are seen only during the acute stage of the infection.

Examination of the cervix shows it to be infected in almost all cases of chronic gonorrhœa. At first the organ is swollen and congested, exuding a heavy mucopurulent discharge. Erosion may or may not exist. As time goes on the cervix returns more nearly to normal size, congestion is lessened, and the discharge is lighter in color. Once infected the tubular glands lining the cervix hold the invading bacteria safe from destruction by medicated douches or local applications. Long after the secretion is clear and colorless the gonococcus may still reappear following coitus, menstruation, or the application of an irritant.

It is variously estimated that the glands of Bartholin are infected in from 15 per cent to 60 per cent of women suffering from chronic gonorrhœa. In the reported cases less than 25 per cent required treatment for this condition. The finding of congestion about the orifice of the duct, the expulsion of pus on massage, the presence of tenderness, enlargement or induration of the gland are signs of inflammation. After sterilization of the cervix and para-urethral glands failure to eliminate this focus may result in reinfection. Frequently one finds a neglected focus in these structures to account for a continued purulent secretion about the vulva long after the cervical and urethral secretions are inactive.

The end stage of urethral gonorrhœa is an infection in the two small tubules described by Skene. A history of burning or painful urination at any time after the onset of infection casts suspicion on these structures. Stripping the urethra downward with the index finger in the vagina will reveal a small drop of pus if the glands are involved and the patient has not voided recently. If the ducts are not high in the meatus, a drop of pus will appear on either side, corresponding with the duct orifices. If one introduces a wire hair pin probe into one of the glands, it will be found to run from one-quarter to one-half inch up the floor of the urethra. Unless active measures are taken to eliminate infection from these structures they offer one of the most persistent lesions with which the gynecologist has to deal. About 40 per cent of our cases were treated for infection in these tubules.

Continued failure on the part of the profession to recognize and adequately treat this disease in the above mentioned anatomical points is responsible for the poor results in the treatment of gonorrhœa. Any successful treatment of gonorrhœa requires the eradication of the disease from these foci. As one is dealing in each case with complicated gland structures, this can best be accomplished by removal or destruction with the cautery.

The application of the cautery to the canal of the cervix is seldom painful and is usually done without anæsthesia. A small nasal tip cautery is introduced into the cervix as far as the internal os, the current is then connected, and the tip is gradually drawn outward. One or two such strips are made at a time, an effort being made to confine the application to one or two sides of the canal. Little or no pain is felt unless the heated instrument comes in contact with the vaginal mucous membrane. The extent of the cauterization at any one time depends on the ease with which it is borne by the patient, the chronicity of the infection, and the relation of the time of treatment to the menstrual cycle. From two to four treatments at intervals of from 10 days to 2 weeks are usually given. This repeated application of heat in the canal is a factor in the result as it kills the bacteria in the glands. Nabothian follicles and erosions respond rapidly to treatment. When anæsthesia is necessary in giving treatment an effort is made to complete the cervical cauterization at one time. If this is done, the patient is confined to bed afterward and to date no bad results have occurred. Immediately following

[1] Read before Chicago Gynecological Society December 19, 1924. (For discussion, see p. 585)

treatment the cervical discharge is profuse. Bleeding for several days after cauterization is common but not severe and patients should be informed of this possibility. Vaginal douches are not given in the first few days following treatment. As a rule, cervical secretion is scanty by the sixth week after the last cauterization.

The method employed in eradicating the glands of Bartholin vary with the type of lesion. If both glands are infected general anæsthesia is preferred to local infiltration. Injection of the duct with silver nitrate is uncertain and difficult. Surgical removal is preferred if the gland is large and either abscessed or cystic. When the gland is hard and shotty it is sometimes easy to grasp in a Jacobs forceps passed through a small incision in the skin or mucous membrane. The adherent tissues are tied in a ligature and the gland removed. Black silk should be used in closing the skin and mucous membrane. Frequently, cauterization of the duct seems advisable even though the gland is excised. A fine double wire tip is used. After operation, particularly cauterization, the area remains tender for many days. Primary union following surgical removal is less frequent than after the excision of non-infected Bartholin gland cysts.

Cocaine application or novocain infiltration of the surrounding tissues is necessary before cauterization of the para-urethral glands. Probes are placed in each of the ducts. A fine wire tip is employed and one burns down through the floor of the urethra to the probe. A small flat retractor is used to protect the anterior urethral wall from the heat. The administration of large doses of alkali 24 hours before and after this treatment prevents painful urination. Stricture is prevented by subsequent dilatation with the Kelly dilator. Bleeding sometimes makes it impossible to destroy more than one duct at a time. Frequently, incising each duct with a fine bistoury is less painful and less damaging to the surrounding tissues than the above method. If the ducts are opened in this manner their bases are cauterized with pure silver nitrate. Urethral smears are usually free from gonococci as soon as healing is complete.

Three years ago I became associated with Dr. Carl Henry Davis on the summer service at the Milwaukee County Hospital and since that time have been assigned the care of these cases. After considering the various methods of treating gonorrhœa, it was decided that the cautery method was particularly applicable for this clinic. The material consists largely of girls confined to the hospital by the courts until such time as they are free from disease. They are therefore of value for study only during the time they are confined to the hospital. Where examination revealed active tubal complications this treatment was not employed. This report covers 35 institutional cases in which we were able to carry treatment to completion, plus 48 cases seen in private practice. We were able to obtain three negative smears and released these 35 hospital cases after an average confinement of 43 days following the first treatment. Examination of the hospital records previous to the institution of this treatment shows that it gives a considerable decrease in the number of hospital days per patient in addition to the incomparable improvement in results obtained. When discharged from the hospital, all patients were referred to the Milwaukee County Dispensary for further observation.

After cervical cauterization patients were allowed to be up and about unless abdominal pain or hæmorrhage developed. Although abdominal pain, tenderness, and temperature occurred in three cases, no evidence of tubal extension sufficient to require surgical treatment was found. The cervix was cauterized in a number of instances subsequent to abdominal operation for the removal of infected tubes. Realizing the general tendency to neglect gonorrhœa in the lower passages in these cases, Dr. Davis and I were particularly pleased at the results obtained.

The 48 cases seen in office practice were of more value for subsequent study than those at the County Hospital. Nine were married at the time of treatment and nine have married since. In but one of these eighteen women has there been any complaint of recurrence in the patient, or infection of the husband. These patients were kept under observation for months after gonococci disappeared from smears. In the absence of complications, smears from these patients eventually become not only free from gonococci but practically free from pus cells. If sterilization of the secretions seemed delayed, careful search would usually reveal a neglected focus in one of Skene's or Bartholin's glands. One woman was found to have two cervical canals both of which were sterilized without difficulty. Occasionally anomalous ducts exist about the urinary meatus. The pelvic congestion associated with retroversion delayed the outcome in seven cases. In six of these the introduction of a pessary was possible and was followed by excellent results. Backache disappeared and a marked improvement in general health and vitality occurred as treatment became effective. Leucorrhœa was persistent in active women who spent long hours on their feet.

Cervical cauterization is contra-indicated in acute gonorrhœa, during pregnancy, in the presence of untreated tubal extension, and for several days before and after the menstrual period. The dangers associated with its use are largely theoretical. Hæmorrhage sufficient to require a cervical pack occurred in one case. Cervical stenosis did not follow in any case. Three women are known to have become pregnant and delivered themselves without difficulty. Obstructive dysmenorrhœa never resulted and congestive dysmenorrhœa was relieved by the treatment. Tubal extension might result if cauterization were employed in the early weeks of the disease. One abortion was unwittingly brought on by the treatment. In one case where cauterization of the cervix followed subtotal hysterectomy a fæcal fistula was produced by an overheated tip. Sloughing occurred into a loop of bowel adherent to the top of the cervix. Healing followed in three weeks.

ADVANTAGES

We feel that the advantages of this treatment far outweigh its possible dangers and difficulty. In institutions it affords a means of rapidly sterilizing the secretions in the irresponsible patient, regardless of the degree of her co-operation. Barring complications, responsible patients can be assured a cure. It removes infection at its origin by removing the pathology and combines with this the destruction of the gonococcus in the tissues by the local elevation of temperature. Again the use of the cautery is to be recommended in conjunction with all operations for infected tubes and may either be used at the time of operation or before discharging the patient from the hospital.

A NEW METHOD FOR THE REMOVAL OF STONE IN THE URETER

A Preliminary Report

By A. B. ILLIEVITZ, M.D., C.M., Montreal, Canada

BEFORE describing this new method for removing stone in the ureter, I think it would be well to review the composition and present-day treatment of ureteral stones. Essentially ureteral calculi are renal calculi on their way down to the bladder. They are usually small and may be solitary or multiple.

COMPOSITION

1. The uric acid calculi and urates are responsible for what is known as renal sand; the small solitary and the large dendritic forms are very hard with smooth surface and reddish color.

2. The oxalate of lime calculi are mulberry-shaped, studded with points and spines, dark in color, and intensely hard. They are a mixture of oxalate of lime and uric acid.

3. The phosphatic types are composed of calcium phosphate and ammonium magnesium phosphates, sometimes mixed with small amounts of calcium carbonate. They are very common although they may be deposited around the other types.

4. Among the rare forms are the cystine, xanthine, calcium carbonate, indigo, etc. These stones rarely develop in the ureter proper but they may grow there, and Collinson (2), in the *Lancet*, 1913, described a full stony cast of the ureter.

On descending from the kidney, stones usually meet with three constricted areas: (1) at the renal end, (2) at the pelvic brim, and (3) near its entrance into the bladder wall.

Roentgenograms of ureteral stones are negative in 22.5 per cent of cases. Geraghty and Hinman (3) consider the wax-tipped catheter of Kelly the most accurate method of locating ureteral calculi, and report that in 6 of 35 cases, roentgenograms were repeatedly negative (20 per cent). In another collection they show that 15 of 67 cases were negative, showing an error in 22.4 per cent. In these negative cases the wax-tipped catheter, by a scratch, gave positive evidence of the existence of a calculus, the diagnosis being subsequently confirmed by operation or passing of the stone.

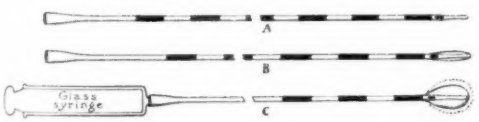

Fig. 1. *A* Ordinary ureteral catheter; *B*, dilating catheter; *C*, same as in Figure 2 inflated with glass syringe.

PRESENT-DAY TREATMENT

1. The urine is kept abundant.

2. In the presence of uric acid the urine is kept alkaline.

3. Morphine is given hypodermically for pain. No medicine is administered by mouth on account of vomiting.

4. Hot sitz baths and hot enemata are used to reduce the tympany.

5. Ureteral catheterization often induces the passage of the stone.

6. Sterile olive oil has been injected into the ureter and pituitrin given hypodermically. Weisz (5) used "sterilized glycerine" to mobilize the otherwise immobile stone. He injected 10 cubic centimeters of warm glycerine and 6 hours later the patient passed the stone.

7. Surgical interference may be resorted to, such as: (a) retroperitoneal and intraperitoneal ureterotomy, (b) removal of stones with forceps through the operating cystoscope or through an opening in the bladder, or (c) incision into the vaginal wall.

Lower (4) says that if a stone remains lodged at one point, surgical intervention should not be too long postponed as delay may result in damage to the kidney or in anuria. Bransford Lewis reports that stones in the lower end of the ureter have been grasped and dislodged after the ureter has been dilated through the operating cystoscope, but Lower thinks that this method may cause a good deal of traumatism. Buerger (1) has suggested a method of dilating the ureter in cases of narrowing or stricture to release impacted calculi. He uses dilating metal olive bougies varying in size from No 6 Fr. to No. 16 Fr. and the d'Arsonval current, the smaller pole of which is applied to the ureter, the larger to the abdomen.

The Garceau dilating catheter has been used by some surgeons.

Rubin's insufflator, an apparatus used to determine the patency of the fallopian tubes, stim-

ulated the author to work out a plan of dilating the ureter with air. The following experiments were conducted on a dog and a rabbit. The animal was anæsthetized with 10 milligrams of morphine per kilogram of body weight. The bladder was exposed and an artificial stone inserted into one ureter at a time. One half cubic centimeter of liquid paraffin was injected and the ureter then ballooned up with a definite amount of air. The catheter was then withdrawn for one-half inch and the process repeated several times until the stone had reached the bladder wall. While the stone very often appeared to pass into the bladder it was also often seen stuck just at the end of the ureter. Therefore the method was considered unreliable from this point of view.

A small piece of thin rubber was then tied to the end of the catheter and by means of a syringe it was possible to balloon the ureter to any desired size. The experiments were then repeated. This catheter was inserted into the ureter near the stone, and after repeated inflations of the catheter and gradual withdrawal of it the stone seemed to follow it downward. At the wall of the bladder the inflations were repeated several times and the last time the catheter was withdrawn quickly in the partially inflated condition. The stone invariably followed the catheter into the bladder.

The artificial stones used were of different sizes. By opening the abdomen of the dog and exposing the ureters the stones could be followed by inspection as well as by palpation.

In the human, no case presented itself to demonstrate the efficiency of this new method, but in a case in which a cystoscopic examination was indicated the author was able to insert the modified catheter[1] into the ureter without any difficulty. The ordinary dental chair or operating table with stools for the feet with the patient in the sitting position, will make it possible for the stone to come down by gravity during dilatation. This arrangement is more comfortable for the patient than the lithotomy position. The writer considers this a very simple and effective method without the disadvantages of surgical interference, metallic dilators, and particularly trauma.

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[1] The catheter prepared by the author is not at present a well finished article, but one local firm is now in communication with a firm in Paris which will manufacture the above described dilating catheter.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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APRIL, 1925

ADVANCED PULMONARY TUBERCULOSIS, A BORDER LINE DISEASE

ARTIFICIAL pneumothorax, the filling of the pleural cavity with gas, as originally proposed by Forlanini and Murphy, has proved to be a most valuable means to the internist and specialist in treating pulmonary tuberculosis in the early stage. It produces collapse with compression of the diseased lung and puts it at rest, favoring thereby the formation of connective tissue, which gradually envelopes the tubercles in the lung.

Goetze of Schmieden's Surgical Clinic at Frankfort, on the basis of extensive clinical experience, advises, as a routine measure, resection of the phrenic nerve on the affected side at the time when the lung begins to expand again after the period of collapse that was maintained for a number of months or years by means of intermittent repetition of the instillation of the gas. Whether this postulatum should stand remains an open question at this moment. But likely Goetze is right, for the unilateral artificial paralysis of the diaphragm will naturally greatly reduce the normal physiologic activity of the reexpanding lung, in fact almost put it at rest. And rest, as we know, has a strong tendency to check the advance of the chronic infectious local inflammation caused by the tubercle bacillus.

Goetze also repeatedly succeeded by means of resection of the phrenic nerve alone in arresting obstinate hæmoptysis in the early, most aggressive stage of consumption, thereby greatly improving the general condition of these seriously ill patients.

Another wise addition to the treatment of pulmonary tuberculosis in its early stage promises to be the methodical use of Kuhn's lung suction mask, or of a similar contrivance yet to be invented. It undoubtedly deserves a careful further trial on a larger scale. It implies the addition, to the beneficial effect of rest, of Bier's hyperæmic treatment, this most powerful weapon in the fight on conservative lines against a localized surgical tuberculosis. The lung suction mask does for the lung what the elastic bandage and elastic neck band do for the extremities and the head: it produces a chronic hyperæmia of the lung, thereby also inducing the formation of connective tissue, which gradually surrounds the tuberculous foci. Besides it represents the best remedy on physical lines against the frequently present chronic anæmia of tuberculous patients.

In cases in which the visceral and costal pleuræ have become widely adherent, the filling in of the gas is technically impossible. In former years the great majority, if not all, of the patients, thus afflicted, were doomed to die.

Suffering humanity and science owe it to the ingenuity of Ludolf Brauer, professor of internal medicine, formerly of the University

of Marburg, that help can be brought now also to these patients. By suggesting to his colleague at the head of the surgical clinic at the same University, that he make movable the entire chest wall with the inwardly attached lung by means of resecting the upper ten ribs, obtaining thereby a pulmonary collapse comparable in amount with that obtained by artificial pneumothorax, he made advanced pulmonary tuberculosis a border-line disease. On December 11, 1907, the late Paul Friedrich performed the first radical operation of this type on a patient with advanced phthisis, who had proved absolutely irresponsive to any other method of treatment at the hands of Brauer. With the help of Schede's operation, designed for intractable chronic empyema, the arm was raised, and the second to the tenth rib cut out in their entire length, together with their periosteum and the intercostal muscles. The patient survived. Today, 16 years after the operation, he is completely cured.

This most radical interference was modified in the course of years by Friedrich himself and by others. Today the original Brauer-Friedrich operation has been abandoned. We have instead as standard operations the paravertebral resection of the ribs by Sauerbruch (paravertebral extrapleural thoracoplasty), the subscapular paravertebral resection of the ribs by Brauer (subscapular paravertebral extrapleural thoracoplasty), and the columnar resection of the ribs, posteriorly and anteriorly, by the late Wilms of Heidelberg. All three modifications of the original procedure are, it seems, useful operations. They are best carried out under local and regional anæsthesia with careful preservation of the attachment of the muscles to the periosteum of the ribs. Their ultimate effect also is thorough collapse and compression of the lung, putting it out of commission, with formation of connective tissue, which encapsulates the tubercles.

It is to be hoped that many of the able surgeons of this country will take up this work in conjunction with one of their trained and trusted colleagues in medicine. The operation as such is technically not difficult. The use of local with regional anæsthesia does away with the necessity of utmost speed in operating, although team work during the operation is essential. It certainly would be deplorable and a hardship for these patients and their relatives, if they were compelled to make long journeys in order to reach a surgeon who has training in this work.

A few of the prerequisites for success in these operations on tuberculous patients are:

1. A proper selection of the cases for operation.

This is a difficult task which can be solved only by most careful study of the patients and harmonious cooperation on the part of specialist and surgeon. Cavity formation in the upper lobe with far-reaching adhesion of the pleural leaves and beginning cicatricial retraction of the affected side, while the opposite lung is not yet or but slightly involved, represents the most favorable condition for operation.

Strictly technical questions must be solved by the surgeons alone, as for instance, should the operation be done in the individual case in one, or in two, or in more stages? Should the eleventh rib be resected with the others at once or later, etc? Resection of the first rib, in conjunction with the other nine, is, by the general consensus of opinion, imperative in every case.

2. Most attentive postoperative supervision of the patients on the part of the surgical staff and of the nurses, particularly during the first days of aftertreatment.

This postulatum rolls up the question of where best to conduct the aftertreatment. Private patients will pay for special nursing;

the poor cannot afford to have it, except when a special fund has been created for this very purpose at the various hospitals. For that reason the poor would be best off in the wards. However, in the State of New York—perhaps also in other States of the Union—regulations of the State Board of Charities forbid the admission of patients with active tubercle bacilli in their sputum to the public wards of our hospitals. Whether this ruling can be sustained remains to be seen, since reliable statistics have proved the non-existence of direct infection by tuberculosis in grown persons. The mitigation of such ruling would promptly increase the number of patients who could enjoy the blessings of modern surgery.

3. Proper direction of the patients when discharged from the hospital.

In view of the frequently present tuberculous process of a milder type in the opposite lung, where are they to go? Should they be sent to a cool climate in the mountains of the North, or to a dry and sunny region of the South? Certainly most intensive heliotherapy appears indicated. Perhaps further experience with the artificial (alpine) sun will prove this apparatus to be a satisfactory substitute when circumstances do not permit migration.

4. Continued observation and advice to these patients by the further actively cooperating internist and surgeon.

Paramount to everything else is the requirement that the internist and surgeon assume the rôle of spiritual adviser. Neither must ever relax in his efforts to kindle anew the hope of the patient, who has successfully pulled through the ordeal of the operation, for continuous improvement and ultimate cure. They must in fact make it a point to inflame hope, this priceless possession of so many chronic sufferers, particularly of so many among the consumptives. Let the medical man confide his personal worries and fears—should there be any—to the patient's relatives, but never let him crush the patient's hope.

A number of important questions may have to be answered later on, as for instance: Is phrenicotomy needed to increase the required rest and compression of the lung on the side operated upon? Is there an indication for apicolysis with homeo- or heteroplastic filling of the resulting cavity? Should a tuberculous cavity in the lung, that resists compression, be drained, and so forth.

At the present stage of this fascinating chapter of thoracic surgery it is inspiring to note the wave of interest and enthusiasm that is momentarily sweeping over our States and Canada in connection with the subject. There can be no doubt that the medical profession of the Western Hemisphere will do its full share to solve the many questions and problems still continuously arising in our endeavors to help patients with tuberculous affection of the lung by means of surgery, after ordinary means have failed.

What improvement the excellent work of the National Societies for the Prevention of Tuberculosis throughout the world has achieved at the very beginning of the thorny path of fighting pulmonary tuberculosis, viz., the gradual lowering of the occurrence and development of the disease, operative surgery today is accomplishing at the other end of the road, by improving or curing between 50 to 60 to 70 per cent of the patients, who heretofore had been utterly lost. Advanced pulmonary tuberculosis—a border-line disease!

WILLY MEYER.

CARCINOMA OF THE THYROID

EVERY patient between the ages of 25 and 60 years who has a nodular goiter should be warned of its danger and advised to be relieved of it by an early operation.

This opinion may seem radical but is justified by the facts that in lesions of the thyroid the incidence of malignancy has been reported to be as high as 6.75 per cent; and that, with our present knowledge, by the time a pre-operative diagnosis can be made, in most cases, the patient's chance for cure has been lost.

Malignant tumors of the thyroid gland are not common, but records prove that they do occur more frequently than is generally believed. Although the average incidence recorded in the literature is less than 1 in every 300, necropsy reports show as many as 1 in every 93 postmortem examinations.

In goiter cases the incidence of malignancy varies considerably. Kocher reports a percentage of about 7.45 and Wilson of the Mayo Clinic 1.75. The average incidence for this country is about 3 per cent. The lesion appears most frequently between the fiftieth and sixtieth years and is found about twice as often in women as in men.

As a rule, cancer of the thyroid is preceded by a benign goiter, usually of 5 or more years' standing. Occasionally the neoplasm develops primarily upon the normal thyroid tissue. In 79 per cent of Wilson's cases a pre-existing goiter was present, in 78.5 per cent of the cases of Speese and Brown. The majority of the other writers agree with these figures. On the other hand, a few surgeons, Bloodgood and Chambers, for example, think it probable that in many cases the condition is a continuous slow development of a malignant goiter rather than a malignant growth superimposed upon a benign one.

A distinct predisposition to the development of the malignancy following acute infections has been noted by several writers, and it has been observed that in many cases the malignancy began after an attack of influenza.

A case may be regarded as malignant when there is a sudden increase in the rate of growth of a long standing nodular tumor of the thyroid, especially if the patient is over 35 years of age. The symptoms in the early stages vary considerably and frequently simulate those of a benign goiter, so that as an aid to diagnosis symptoms are not reliable. This is one reason for the contention that all enlargements of the thyroid, excluding the adolescent types, should be removed surgically as soon as possible.

Usually the patient first notices symptoms of pressure on the larynx, trachea, œsophagus, and neighboring nerve trunks. Pain in the neck extending to the temples and behind the ears occurs frequently. Various cardiovascular disturbances and angina-like pains are likely. As the disease progresses the symptoms become aggravated. The pain becomes constant and severe. Œdema of the surrounding structures may develop causing dyspnœa and dysphagia. Intratracheal hæmorrhage may occur. The tumor becomes large, hard, and fixed. The patient becomes anæmic and loses weight rapidly.

Metastasis can occur anywhere in the body, although it is found most frequently in the lungs. A prolonged death finally results, occurring either from local invasion of neighboring organs or from the metastasis in the lungs, brain, and liver.

The surgeon's chief interest is in an early diagnosis, for unless the patient comes when the goiter is still simple or during incipient or beginning malignancy, an operation may be merely palliative. In all cases there is a chance for permanent cure by operation, the chances varying with the type of tumor and the stage at which the patient comes to the surgeon. Broadly speaking, sarcomata offer very little hope for cure, the average period of life after operation being about 6 months. Patients operated upon for malignant adenoma of the

thyroid live about 1 year and 5 months, and for malignant papilloma about 2 years and 9 months (Wilson). If operation is done early, before the malignancy has penetrated the capsule of the thyroid, approximately 70 per cent of the cases are permanently cured.

Cases of malignant goiter should be treated by removing as much as possible of the gland even to the extent of producing a hypothyroidism. The parathyroids should not be removed. The operation should be followed by extensive X-ray treatment, the X-ray being used in preference to radium. The hypothyroidism can be taken care of remarkably well by the feeding of thyroxin or desiccated thyroid gland.

The pathological classification and diagnosis of thyroid tumors are frequently extremely difficult, grossly, and when viewed under the microscope. Not uncommonly a competent pathologist is unable to distinguish between the benign and the malignant growths, such as, for instance, the fetal adenoma and the malignant adenoma.

Generally speaking there are three distinct types of malignant tumors of the thyroid: first, the adenocarcinomata which are the most common; second, the malignant adenomata, and last the relatively rare sarcomata. The adenocarcinomata vary considerably, but as a rule can be readily recognized under the four principal variations; the papilloma, medullary carcinoma, scirrhous carcinoma, and the carcinosarcoma.

The malignant adenomata are not so easily recognized, as it is almost impossible at times to distinguish between the benign proliferating adenomata and the malignant type. Generally speaking, if the proliferating adenomata tend to penetrate the capsule, invading other portions of the gland, they can be classed as malignant. From this it can be assumed that in a person of cancer age any sizable adenoma of the thyroid which histologically shows active proliferation is potentially malignant even though it is still contained entirely within its capsule.

C. G. TOLAND.

MASTER SURGEONS OF AMERICA

ARPAD GEZA CHARLES GERSTER

ARPAD GEZA CHARLES GERSTER was born December 22, 1848, in Kassa, Hungary, now Czecho-Slovakia, and died at his home in New York City, March 11, 1923. He received his early education in the schools of his native town, chiefly under the teaching order of white Premonstratensians. He graduated in medicine from Vienna in 1872, and arrived in America March 9, 1873.

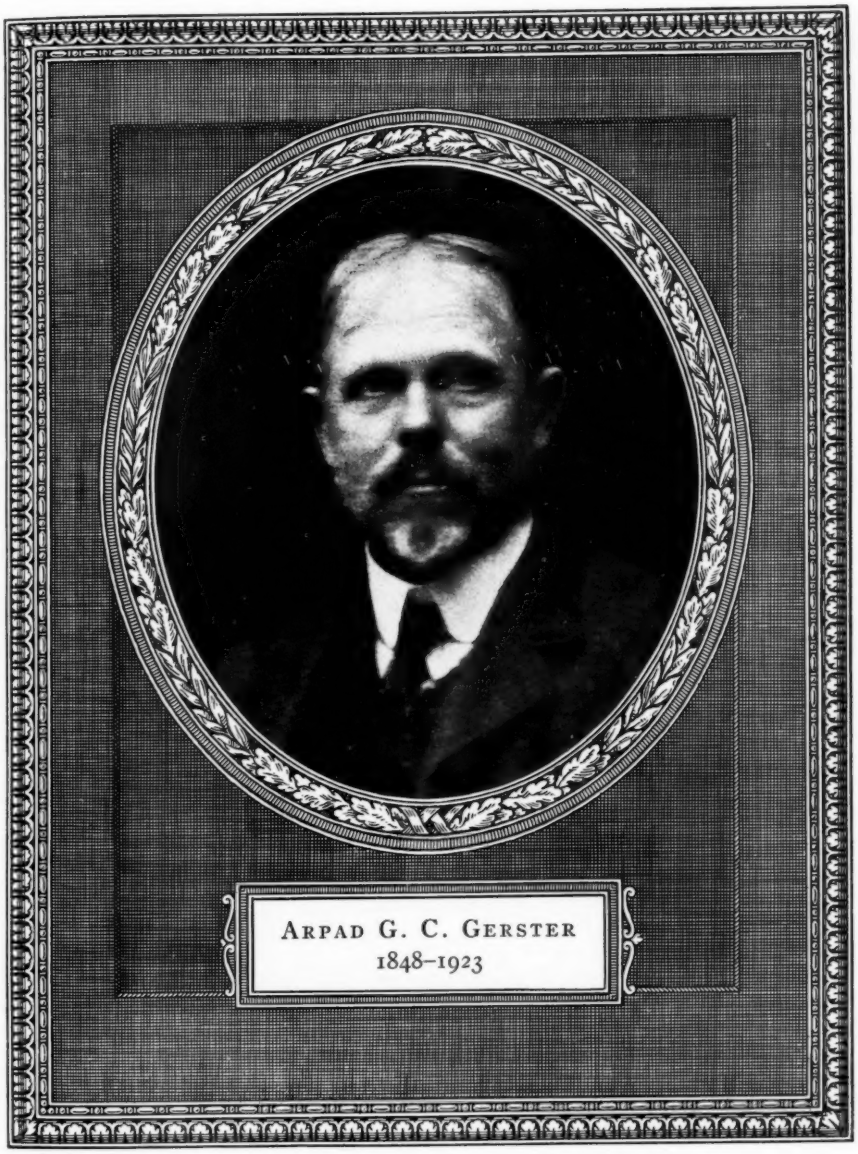
Gerster was the first man in New York to practice surgery exclusively. In 1878, when he was thirty years of age, he was appointed attending surgeon to the German Hospital, New York, and two year later to a similar position at Mount Sinai Hospital. From 1882 to 1895 he held one of the two chairs of surgery at the New York Polyclinic Medical School. Practitioners came to this institution from all parts of the United States for graduate instruction.

Other positions of note held by Dr. Gerster were: fellow, New York Surgical Society, 1884; member, Century Association, 1890; president, New York Surgical Society, 1891; consulting surgeon, German Hospital, 1896; vice-president, American Surgical Association, 1908; president, Charaka Club, New York, 1909; professor of clinical surgery, Columbia University, New York, 1916; president, American Surgical Association, 1911–1912; consulting surgeon, Mount Sinai Hospital, 1914; and trustee, New York Academy of Medicine, 1916.

In 1902 Dr. Gerster was asked, informally, if, in event it should be offered, he would accept one of the two chairs of surgery at the University of Budapest. This was declined because, as he afterward said, "I had become heart and soul an American. Where my name and reputation were made, there I proposed to serve to the end of my allotted time."

About 1894, the Austro-Hungarian Government decorated Gerster with the Order of Francis Joseph, in recognition of his great charity to poor Hungarian immigrants. A few years later, in 1906, following political action by Austria to Hungary, which he considered unjust, he returned the decoration, maintaining that if he kept it, his independence of thought and speech would be hampered, an action most typical of him.

These brief reminiscences with regard to one of the great surgeons of the world, will seem hackneyed to those who knew and loved the man, and who were intimately acquainted with the originality and richness of his wisdom.



ARPAD G. C. GERSTER
1848–1923

One other man, Christian Fenger, born and educated in another country, came in his youth and strength to make America his home. Christian Fenger in the West, and Arpad Gerster in the East, wrought greatly, and stand out preeminently in the history of American surgery. Each contributed mightily to the spread of the new doctrine of asepsis and antisepsis which had been made possible by the work of Louis Pasteur and Joseph Lister. Each, after contributing work of a lifetime to the upbuilding of American surgery, died in the country of his adoption, his name hallowed by a reverent medical profession, and by untold numbers who, directly or indirectly, had benefited by him.

Shortly after I graduated in medicine I went to New York, at the suggestion of my father, to take graduate work in the Postgraduate and the Polyclinic schools, which were at that time in their infancy. Gerster was one of the men with whom I came in contact. He was a forceful, enthusiastic teacher, who opened up to me a new viewpoint in surgery. During succeeding years my brother and I made frequent visits to New York, never failing to spend a share of our time with this remarkable teacher and operator at the Mount Sinai Hospital.

Gerster's medical confrères said of him that he was a physician first, and a surgeon second, for he regarded the patient from the broad standpoint of general medicine rather than from the narrower standpoint of surgery. This gave to his opinions a peculiar value. Diagnoses carefully established led to indications for treatment in which the soundness and originality of his judgment were demonstrated. Few men have equaled him in the wisdom of his surgical indications. He was bold and fearless, and did not hesitate to decline to operate if, in his judgment, the patient would not be greatly benefited thereby. As an operator he was original and courageous. Adequate exposure was a *sine qua non*, since he maintained that careful work could not be done except under guidance of the eye. Under atypical conditions, improvisations were readily devised by him. In postoperative care, his broad medical knowledge and sound judgment were the admiration of colleagues and pupils. His kindness to patients and his conscientious care of them were proverbial. A strict disciplinarian himself, nothing excited his anger more quickly than lack of such qualifications in a subordinate.

Gerster's book, *The Rules of Aseptic and Antiseptic Surgery*, was published in 1888, for those times a veritable edition de luxe, printed on heavy calendered paper with many illustrations by the half-tone process, then almost unknown in its application to scientific books. In order to obtain these illustrations, Gerster mastered the technique of photography and made his own plates, and this when photography by an amateur was quite rare. The book caused a furor, for at that period suppuration was considered a natural sequence of every surgical procedure. It was immensely popular and passed through three large editions in less than two years; that it did not pass through many more editions was due to Gerster's modesty. He said, "My book has done its work." I once heard Dr. Edmund

Andrews, of Chicago, say that this book was the greatest contribution to surgery of the time, and this is well demonstrated by its effect on the American profession. It so thoroughly taught diagnosis, pathology, and technique, as represented in the new school, that students were able to carry out to the extent of their ability the methods discussed, and young men with this new knowledge were able to better the work of older men whose experience proved a handicap. As I look back on that earlier period, I remember three books that helped to form my surgical mind: *Abdominal Surgery*, by Greig Smith, of Bristol, England; *Operations of Surgery*, by W. H. A. Jacobson, of Guy's Hospital, London; and *The Rules of Aseptic and Antiseptic Surgery*, by Gerster.

Gerster's interests outside of medicine were broad. Music, art, literature, and life in the open, his greatest diversion and recreation, were all enjoyed with a keen zest. His sister, Etelka Gerster, notable as an operatic artist, greatly inspired him in his love for music. He wrote well on many topics, and copies of etchings made by him are among the print collection of the New York Public Library. Toward the close of his life he limited his professional work to consultations, and devoted his leisure to writing, and to painting in oils. In 1917 he published an auto-biography, *Recollections of New York Surgeons*, which portrays vividly the development of surgery from the time of his student days to the present.

Gerster was a great man, and unusual. The distinguished honors which came to him were unsought. He loved his work, and lived for it. W. J. MAYO.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD DECEMBER 19, 1924, DR. CAREY CULBERTSON, PRESIDING

FIBROMA OF THE OVARY; A PSEUDOMUCINOUS CYST OF THE OVARY

DR. W. C. DANFORTH: A woman, age 38, had been complaining of pain and menorrhagia. We did a supravaginal hysterectomy because she had a rather large boggy uterus, which was retrodisplaced, and an enlarged ovary on the left side. A diagnosis of ovarian cyst had been made prior to operation. The specimen, however, proved to be a fibroma of the ovary about 3 centimeters in diameter. Fibromata of the ovary are not particularly common; I think this is the third one we have had in our own hospital in the past 10 years.

The second specimen is a large bilocular pseudomucinous cyst of the ovary. There is nothing particularly interesting about the case except that it occurred in a patient who was 15 years of age and it happens to be the largest cyst that I have ever encountered in a girl of that age. The entire mass weighed 7000 grams.

BLINDNESS FOLLOWING THE USE OF THE ACTUAL CAUTERY

DR. ARTHUR H. CURTIS: This was a patient of Dr. Gibson's whom I saw with him. Three years ago Dr. Gibson performed a cæsarean section. The woman was a Christian Scientist and drifted away from him so that he did not see her until about a year and a half ago when he gave her radium treatment because of bleeding. Some few months ago when she again reported, he not having seen her in the interim, she had a hopeless carcinoma of the cervix. We looked at her together and under anæsthesia found such a hopeless necrotic, bleeding mass that it appeared not desirable to give radium or even to use diathermy, but instead we applied the actual cautery to check the hæmorrhage. Two or three days subsequent to that she had difficulty with vision. Within a week she was completely blind and remained blind until her death last night. An autopsy was performed this morning, but the results of cranial examination will not be available until the tissues have been hardened for 2 weeks. This is the first case of blindness following the use of the actual cautery at St. Luke's and the first I have known of or even heard of.

DIPHTHERITIC VAGINITIS: REPORT OF TWO CASES

DR. ABRAHAM F. LASH reported two cases of diphtheritic vaginitis (see p. 556).

DISCUSSION

DR. HENRY F. LEWIS: I have had one case of diphtheritic vaginitis and I am rather inclined to believe they are rather uncommon. I think that we are all agreed that they are.

CHRONIC GONORRHŒAL ENDOCERVICITIS

DR. HAROLD W. SHUTTER, Milwaukee, Wisconsin (by invitation) discussed chronic gonorrhœal endocervicitis (see p. 572).

CHRONIC ENDOCERVICITIS—ITS CLINICAL IMPORTANCE AND RESULTS FROM TREATMENT WITH ELECTRIC CAUTERY

DR. CARL HENRY DAVIS, Milwaukee, presented a paper on chronic endocervicitis (see p. 568).

DISCUSSION

DR. T. J. WATKINS: Drs. Shutter and Davis have discussed an important subject in a way that offers scant opportunity for criticism.

Dr. Davis may have been somewhat extreme in describing the injurious effects from chronic infections of the cervix, especially focal infections in the production of arthritis. I have never detected a case of arthritis due to chronic pelvic infection, although many cases of arthritis have been referred to me as possibly due to pelvic infection. The papers justly stress the fact that a chronic purulent vaginal discharge is detrimental to health and especially to strength.

I would urge adoption of the technique of removal of sebaceous cysts for infected Bartholin's glands.

These papers, supported by the observations of Kelly, Dickinson, Holden, Bovée, and others, on the curative results from cautery, deserve serious consideration.

DR. N. S. HEANEY: I am always glad to hear a new paper on leucorrhœa and endocervicitis because I am not completely satisfied with the methods of treatment that I employ. In spite of all I do, occasionally I have stubborn cases which resist all

treatment. On the other hand, we must not forget the fact that frequently the worst sort of cases get well without any treatment. I have used the cautery treatment in times past, but have discarded it because my percentage of failures was larger with it than by operative treatment.

I was very much interested in hearing Dr. Watkins say what he did regarding the cervix as a focus of infection for a systemic disease such as arthritis or neuritis. I have examined hundreds of cases with the idea that the cervix might be the cause of a particular arthritis or neuritis and have not been able, in a single case, to convince myself that it was, except in acute gonorrhœal conditions. Earlier, in about 15 cases in which arthritis was associated with other pelvic disease making operation advisable, I have removed the uterus with the cervix. Not a single one manifested any improvement in the arthritis.

Dr. Davis spoke about endocervicitis as inciting malignancy. I am very doubtful regarding any relationship existing between a diseased cervix and a carcinoma developed therefrom. I also have had only one case in which carcinoma was found microscopically, so that it could not be diagnosed without the use of a microscope.

Dr. Albert Goldspohn: I wish to express my approval of the two papers presented this evening as being theoretically sound and practically effective. The treatment of the gonorrhœal cervix is best considered when we follow the natural course of the disease. The cervical canal is normally lubricated by the mucous follicles and glands that penetrate even into the submucosa. Upon invasion by the gonococci these follicles and glands multiply and become extremely active in producing an extra amount of the peculiar thick, tough, and tenacious mucus which tends to fill the cervical canal and acts as an absorbing plug in arresting the invaders. If this process of nature is not interfered with during the acute stage, it certainly prevents many cases of gonorrhœal endometritis with the certainly following salpingitis. It is for this reason that it is not wise during the acute stage of the infection, to apply active local treatment further than the external os uteri. I usually wait until a smear from the defensive mucus is devoid of germs. There are then two reasons for applying for local treatment: first, to kill the cocci that probably remain in the diseased hyperplastic mucosa and its products; secondly, to destroy or remove the accumulated cervical mucus and the hyperplastic mucosa that is abnormal in amount and in composition—so that a healthier mucous membrane can be regenerated from the deeply seated radicals of mucous glands. Sterilizing the cervical canal can be accomplished by radium, and also by diathermy; but it can not be reasonably expected that these remedies will also remove the grossly pathologic tissues that remain. Destructive cauterization or mechanical removal of these tissues will be needed before leucorrhœa will stop and the cervical canal approach a normal condition. One of the essayists stated that his experience was that the radium cases had a persistent discharge after the treatment.

Years ago I also treated these cases with the galvanocautery, but found it to be rather too painful for most patients. I soon found in 95 per cent solution of carbolic acid the two benign and extremely valuable actions—local anæsthesia and a safe cauterization. The cervix is steadied by a bullet forceps caught upon its vaginal covering. Within a bivalve speculum containing alcohol enough to neutralize the excess of acid to prevent cauterization of the vagina, we apply the acid on a cotton covered wire applicator. This is followed by the use of cervical dilating sounds, and then we alternately repeat the applications of the acid and the use of a curette. This procedure can be carried out with little pain to the patient. Because of the anæsthetizing cauterization a thorough removal of the pathological tissues from the cervical canal and its pouches can often be made in one sitting. However, it is sometimes better not to do so much at one time. This treatment can be repeated to the extent needed, after an interval of about 4 weeks. In the meantime and after every such treatment, as long as there is a vaginal discharge, a daily vaginal douche is advised, preferably of about one part of Dakin's chlorine solution in from 30 to 40 parts of sterile water. In nearly all cases, if not complicated by a pathologic displacement of the uterus or by an abnormal condition of the endometrium, the leucorrhœa will stop. This is the best answer to theoretical critics who contend that the gonococci remain in the deeply seated radicals of the cervical mucous glands, from which the new mucosa is regenerated. They do not, if this treatment is properly executed; nor is the reasonable joint use of carbolic acid and curette so destructive as to invite stenosis.

Dr. C. S. Bacon: I would like to ask Dr. Davis if he can explain the mode of action of the cautery on the tissues between the cautery strips, taking for granted that the cautery goes low enough to touch the tissue immediately below. What happens in the tissue between the cautery cuts? Is there not considerable tenderness?

Dr. A. H. Curtis: Perhaps no one has expended more effort than I in attempts to unravel the problems concerned with infections of the female genital tract. We have made some progress. It has been learned that the body of the uterus tends to remain free from chronic infection. We have learned, also, that the cervix is a much more important focus of disease than we appreciated formerly. We know that, in those instances in which the disease is limited to the cervix, the trouble affects particularly the glands of the cervix, with associated hyperplasia of the glands and increased secretion. When the infection is limited to the cervical glands it is easy to effect a cure. Unfortunately, this occurs in only a modest proportion of cases. Although we can cure patients with an infection of the cervical lining, there are many that have infection which infiltrates the

deeper, inaccessible tissues; these are exceedingly difficult to relieve. My experience relative to focal infection coincides with that of Dr. Heaney and Dr. Watkins. Although we quite often find bacteria, even streptococci, in rather generous numbers, it seems that removing the lining of the cervix seldom cures the infection.

Dr. Heaney asked us to give testimony regarding the recognition of cancer of the external cervix. My experience with cancer, which cannot be recognized at the time of the gross examination at operation, is limited to 5 patients.

Dr. Irving Stein: May I say a word in defense of the less destructive forms of treatment? I think the whole discussion concerned the more severe methods. Dr. Heaney states that some of these cases will heal without treatment, and in between there are numerous cases which will respond to antiseptics which do not destroy tissue. I have particular reference to the use of mercurochrome solution which I have used in this work for the last 3 years since beginning my investigations with vulvovaginitis in children. Finding it effective there I applied it to the cervix, to Skene's and to Bartholin's ducts and found it quite adequate, though I am not in a position to state any percentage of cures. It is not at all irritating though it does require repeated treatments; often the course is prolonged to 3 or 4 months. I think many cases of endocervicitis do not require such radical treatment and I think the use of an antiseptic which combines chemically with the diseased tissue, as mercurochrome does, is worthy of our consideration.

Dr. Carl Henry Davis (closing): I agree fully with Dr. Stein regarding the value of mercurochrome in treating the acute conditions involving the cervix and vagina. As an adjunct to the cautery it is used for the chronic conditions involving the cervix. A girl recently discharged as cured, 6 weeks after a cautery treatment of the cervix, previously had been treated medically by a colleague with mercurochrome for a year with only slight improvement in the chronic gonorrhœal endocervicitis.

Relative to the cervix as a focus of chronic infection, I agree with Drs. Watkins, Heaney, and Curtis that the treatment of the cervix will not cure arthritis. But in any effort to treat this condition all available foci of chronic infection should be eliminated. It is our experience that the clearing up of a chronic endocervicitis is frequently followed by a relief of pelvic tenderness and other annoying pelvic symptoms. Is it not worth our attempting to cure these cervical conditions before they reach the stubborn chronic stage? We have been astonished at the rapid healing which follows the use of the nasal type cautery about 2 months after delivery.

Since there has been no opportunity to study microscopically the process of healing it is impossible to give a definite answer to Dr. Bacon's question. We always aim to burn through the glandular structures. There is sufficient heat to kill the bacteria without destroying all the cellular structures between the cautery incisions. Healing seems to occur by a filling in from the tissue which survives. This undoubtedly results in a certain amount of scar formation, but when the nasal type cautery is used there is not enough scar tissue to cause a cervical stenosis. If the cautery lines are too far apart it will be observed, as shown in Dr. Dickinson's drawings, that healing is found along the cautery lines rather than between them. I have had satisfactory healing, with two or three cautery treatments in the office, of cervical conditions previously treated several times per week with chemicals, tampons and douches over long periods with little or no improvement. One such patient reported on 3 successive months and had no treatment between the cautery applications. Two months after the third treatment perfect healing was found and she is now pregnant. Her pelvic tenderness and backache are relieved.

When Dr. Dickinson read his paper in 1921, I regarded his statements exactly as Dr. Heaney does mine tonight. My previous experience had been with either a heavy electric or Paquelin cautery used on the cervix of patients under anæsthesia, and it did not seem reasonable that there could be such a marked difference in results.

Dr. Heaney: I have been using one of those fine cauteries with a cambric needle.

Dr. Davis: Your cautery may be too fine for use in the cervix.

Spontaneous healing usually results in cysts, and, as Dr. Watkins has suggested, cysts may well follow the use of the cautery, but thus far I have not observed any extensive cyst formation. If they occur we puncture with the cautery and destroy the cyst with heat. This is more effective and satisfactory than the older treatment by puncture and phenol cauterization.

It may be difficult to diagnose early malignancy without the microscope. About 14 months ago I used the Sturmdorf excision on the cervix of a young woman who had a history of leucorrhœa for several years. Microscopically neither the pathologist nor I suspected cancer. However, the sections showed an early squamous cell carcinoma. She was treated with radium and with results which were alarming because of an acute exacerbation of an old pelvic infection. However, she eventually recovered and now appears to be in good health, but for months she has refused further examination.

Dr. Harold W. Shutter (closing): In reply to the question of Dr. Goldspohn: These patients were treated while they still showed gonococci in the smears. Gonococci were present in the smears of all patients treated at the hospital. In acute cases we delay the onset of this treatment until the patient has passed through three menstrual periods. Mercurochrome was employed in the acute stages and sometimes later in conjunction with cervical cauterization.

We have had two patients at the County Hospital in whom chronic gonorrhœa of the cervix was accompanied by chronic arthritis. In neither case

was the condition of the joints improved by cervical treatment. In the application of the cautery blade the destruction extends to the depth of the cervical glands and does not, as suggested, destroy only the superficial portion of the ducts. In going over the histories of patients treated by other methods, we found that frequently they occupied beds in the institution for a period of 5 or 6 months at the end of which time positive smears were still obtained. In all cases treated by the cautery three negative smears were obtained on an average in 43 days. This does not mean that the patient is cured. All patients are referred back to the dispensary for observation. In our private work, we feel that cases should be followed not only until they are free from gonococci but also free from pus cells. It is surprising in how many women cervical secretions become absolutely free from pus cells provided the uterus is in good position and free from congestion. Of the 7 cases in which retroversion complicated gonorrhœa several had been under treatment for 1 or 2 years. After we had treated them two or three times with the cautery, and gonococci were no longer found in the smears, the uterus was replaced, a pessary inserted, and pelvic congestion relieved. Sometimes the leucorrhœa is remarkably reduced in a week.

One phase of the work has been interesting. When we first started using the cautery several men said: "You will produce a stenosis of the cervix and get into trouble." Some of these cases have been watched for over 3 years and no trouble suggesting obstruction has resulted. These patients have no added discomfort with menstruation and are not prevented from becoming pregnant.

Chirurgia
quam crudelem
administrabat
LA
CHIRVRGIE
FRANCOISE
Recueillie des Anciens
Medecins et Chirurgiens
AVEC
PLVSIEVRS FIGVRES
des Instrumens necessaires
pour l'operation Merueille
PAR
IACQVES GVILLEMEAV
Dorleans, Chirurgien
du Roy et Iure
A Paris.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED J. BROWN, M.D., F.A.C.S., Omaha, Nebraska

THE FRENCH SURGERY OF GUILLEMEAU

IT was to be expected that the genius and outstanding superiority of Ambroise Paré should attract the attention of younger men in surgery in spite of the fact that he was the subject of bitter attacks by many surgeons of high position in France. Originality attracts youth. Among the foremost of those who placed themselves under Paré's tutelage was Jacques Guillemeau. His family had been prominent for many years in the surgical world in France and his father had been surgeon in ordinary to the King. Born at Orleans in 1550 he received a classical education and studied the works of the old masters of medicine. He studied anatomy under Riolan; surgery under Courtin; and finally attached himself to Paré as his student and served with him in many of his campaigns where he had the opportunity to observe his work closely and learn his methods. He also saw the work of many other surgeons of different schools and nationalities, and so obtained a well rounded experience and a considerable fund of knowledge, for his work shows him to have been a keen and intelligent observer. He returned to Paris in 1581 and later became one of the surgeons at the Hotel Dieu, and finally in 1595 was appointed prevost of the College of Surgeons. He received many honors at the hands of royalty and served as surgeon in ordinary to Charles the Ninth, Henry the Third, and Henry the Fourth. The date of his death is given differently by various authorities. According to the Index Funereus of the Surgeons of Paris it is March 13, 1609, others give it as late as 1613.

Guillemeau was a prolific writer and covered the field of medicine fairly well. Among his publications are, a treatise on Disease of the Eye, an Anatomy, and works on Obstetrics.

In his treatise on surgery published at Paris in 1594 he apparently had no desire to precipitate himself into any such controversy and unpleasantness as his master Paré had to undergo for he takes every precaution against criticism and absolves himself of any attempt at originality. He likewise states plainly that he is writing the surgery at the request of, and simply for the purpose of teaching younger men and beginners in surgery. With reference to originality, he says (using the English translation) "And if so be any man obiect unto me, that this my discourse is onlye compilede together of certayne rapsodyes of the antique Chyrurgians, I willingly here confes and acknowledge that in this Treatise, there is verye little, or nothing at all of myne own Inventione." This fear of attack seems to run through his mind for he refers to it constantly and as a closing word after entreating the medical profession to receive the work without too much malediction he appends the verse;

"Some men do reade, to reap some good thereof,
Others to mock, and howld thereof a soffe,
It is more ease heerin to reprehende,
Then anye thing therin, for to amende."

He does, however, break out once when in referring to the illustrations of instruments he says: "In like sorte must the Chyrurgiane, an imitatoure, and administre of Nature, endevoure and constraygne himselfe, with few Instrumentes to execute, and effecte, manye & greate operations. And to speake the playne truth all this greate companye and treasure house of Engines, Molitiones, and of other Chyrurgicall Instrumentes, are more for curiousity and ostentatione then for anye necessitye and use."

The surgery proper is divided into several parts. The preface deals with diagnosis and prognosis in wounds and it is interesting to note it contains a chapter on the methods of rendering reports of wounds to magistrates. Then follow chapters on the removal of projectiles and foreign bodies from wounds. Signs and symptoms of fracture of the skull: The treatment and suture of wounds: The opening of abscesses: Diseases of the nose and mouth in which he discusses Hare lip, Epulis and Ranula, and describes removal of the tip of the uvula, and pulling of teeth. In his plates he illustrates false teeth: Bleedings leeches and boxes (cupping): Diseases of the bones and joints and amputations: Cauteries and Setons: Bandages and Splints:

After reading the volume, one is impressed by the fact that he has been reading Paré in a methodical form; and has come closer to Paré's reasoning and methods. This is especially true after having read Paré himself, for delightful as that reading is, it is more in the form of a narrative, and one forgets the scientific because of the preponderance of the personality of the man. Guillemeau had absorbed Paré's science and being a compiler and classifier put the information in assimilable form and gives us Paré's surgical methods with the personality left out.

REVIEWS OF NEW BOOKS IN SURGERY

IT has been a delightful experience to review the recent volumes of Pauchet.[1] There is little question but what carefully selected and prepared illustrations convey more definite and unmistakable information than simple text. Consequently, a textbook has not the clarity characteristic of a manual of well drawn illustrations, each of which is briefly described. The author states in his preface: "This work is not a useless repetition of existing treatises on operative surgery. It is a collection of selected subjects. Instead of writing a work and illustrating it afterward according to theoretical ideas, I have preferred to arrange for the illustrations of my daily operations and to write afterward a text explaining the illustrations. An artist reproduces what he sees as he sees it. . . . It is living surgery." These few words adequately describe the present volumes. Pauchet does not follow any set scheme, as for example in volume i, he illustrates femoral hernia, vesico-vaginal fistulæ, cancer of the rectum, adenoma of the breast, gastric and duodenal ulcer, papilloma of the bladder, and other subjects. A similar diverse collection of subjects is illustrated in volume ii. The illustrations are all exceptionally clear and instructive, the explanatory text is very brief and to the point, but sufficient to connect the various serial illustrations.

Two volumes are before the reviewer and from the preface, we are encouraged in the belief that others will follow. The author states that he has asked some of his colleagues to republish the methods they have practiced with their well known skill and these will appear in due time.

This method of presenting operative surgery is rather an innovation. C. Gordon-Watson, in a general introduction, most tersely expresses the reviewer's sentiments: "The reputation of Victor Pauchet as a bold and brilliant surgeon stands high in Paris. *Practical Surgery Illustrated*, translated into English by Dr. F. R. B. Atkinson, cannot fail to enhance that reputation, and will enable English surgeons to study Pauchet's methods in detail with both pleasure and profit." J. A. WOLFER.

VOLUME IV of the *Annals of Roentgenology*,[2] depicting normal bones and joints, has only recently been released. This volume is a most valuable contribution for the roentgenologist as well as for the surgeon and practitioner. The study of the appearance and evolution of centers of ossification and the chronology of epiphyseal ossification, has, until quite recently, been purely an anatomical study. Now it would seem that much of these data must be changed to conform with modern roentgenological research. The profession has at its command in the roentgen rays, a means whereby individual studies can be made of bone development. There now remains the one variable and doubtful factor, i.e., the correct interpretation of the roentgenological pictures. To fulfill this want, Cohn presents the volume which is before the reviewer. This volume is an atlas consisting of roentgenograms with notes of interpretation. A number of illustrations are added to clarify the text. The list of plates includes individual roentgenograms of the normal shoulder, elbow, wrist, hip, knee, and ankle at various ages. The ages at which these roentgenograms are taken, range from early infancy to maturity. As an example in describing the normal shoulder, the roentgenological studies were made at the following ages: 7 weeks, 5 months, 13 months, 2 years, 3 years, 4 years and 7 months, 7 years and 8 months, 8 years and 10 months, 9 years and 10 months, 10 years and 10 months, 11 years and 6 months, 14 years, 14 years and 6 months, 14 years and 8 months, 15 years and 4 months, 16 years and 10 months, 17 years and 6 months, 18 years and 7 months, and 20 years. A similar range is covered in the other studies. The reproductions of the roentgenograms are excellent. This work should be heartily welcomed by the profession. J. A. WOLFER.

IN a little volume written for and dedicated to the medical student, White again brings to our attention the necessity of a thorough knowledge of the minor details of surgical treatment. The success or failure of a surgical procedure often depends upon the careful management of the many minor details of treatment.

This little work[3] contains many suggestions which the young surgeon as well as the medical student may do well to heed. Much information is incorporated which is not found in the average textbook of surgery and is not given in clinics or classes of instruction. We as surgical teachers advise the student or house surgeon that a turpentine enema will relieve tympany, but we do not tell him how to prepare such an enema. We infer that the nurse in charge knows. We fail to realize that many physicians must practice medicine without the valuable assistance of a trained nurse, and must show some member of the patient's household how to minister to the patient's needs. How necessary then, that the physician himself know the almost countless minor surgical crafts.

This subject has already been rather fully covered in Clayton-Greene's revision of Pye's original work. It would seem though that White's work encompasses a larger and more varied field of detail.

J. A. WOLFER.

[1] PRACTICAL SURGERY ILLUSTRATED. By Victor Pauchet. Vols. i and ii. Translated by F. R. B. Atkinson, M.D., C.M. (Edin. Univ.). London: Ernest Benn Limited, 1924.

[2] NORMAL BONES AND JOINTS. Vol. IV. By Isidore Cohn, M.D., F.A.C.S. New York: Paul B. Hoeber, Inc., 1924.

[3] A TEXT-BOOK OF SURGICAL HANDICRAFT. By J. Renfrew White, M.S. (N. Z.), F.R.C.S. (Eng.) New York: The Macmillan Company, 1924.

ONLY a few years have elapsed since the last edition of Gray's Anatomy was given to the profession, and now there is before the reviewer the twenty-second edition.[1] One cannot but marvel at this masterpiece; the first edition appearing some 65 years ago. During this period of time it has been used by countless numbers of students and physicians. Each edition has brought to the reader the newer developments in anatomical research and today it stands as much an authority as it did 65 years ago. This edition incorporates but few changes. Slight additions have been made on the subjects, musculature of the heart and ductless glands.

J. A. WOLFER.

A HAPPY trend in serious surgical study is to give in one volume all the facts and fiction on a subject. This volume by Calzavara on the inflammations of the pancreas[2] fills a want in gathering for the surgeon all available information on the relatively obscure subject, including a separate bibliography for each division. In the first part is found the medicosurgical anatomy of the pancreas, its blood and lymphatic supply, its relations with surrounding organs, and a discussion of the origin of the islands of Langerhans, 200,000 to 1,760,000 of which are said to be present in the adult pancreas. The physiology of the organ, its accessories and anomalies, and an investigation into the internal secretion problem and its relation to the endocrine system in general is then covered. The etiology and symptomatology of pancreatic affections follow. The main portion of the monograph is devoted to an exhaustive treatise on the inflammations which are divided into acute (necrotic, suppurative, and gangrenous), and the chronic, with or without icterus, including tuberculosis and syphilis. The chapters on the acute suppurative form and pancreatic stone are especially valuable. The surgeon will appreciate the thoroughness of the discussion and the descriptions of the three surgical methods of approaching the pancreas—through the abdomen, through the back, and through the pleura. The author's animal experiments form an addendum. No mention is made of the action of insulin and its bearing on accessory treatment following changes in the gland.

KELLOGG SPEED.

GUILLAUME'S monograph[3] on colotyphlitis and the syndrome in the right iliac fossa is a plea against the habit of both lay and medical men of too easily and loosely making a diagnosis of appendicitis for all ills of the lower right abdomen.

After a minute inquiry into the origin of the terms typhlitis, peri- and para-typhlitis, cæcitis, appendicitis, and false appendicitis, the author concludes there is little to choose from, and to add new terms simply would augment the existing confusion. Reports on appendicitis in connection with gastro-intestinal disorders such as constipation, intestinal parasites, false membranes, etc., are critically reviewed. The theories of the origin of appendicitis and the frequency and causes of error in diagnosis of the condition called chronic appendicitis are discussed in full. Of especial interest are the reports showing the often unhappy results of appendectomy for so-called chronic appendicitis. Guillaume says that we are always ready to excuse failure in diagnosis of chronic appendicitis by affirming that (1) there was a co-existing lesion or a functional disturbance of an organ near the appendix, (2) there appeared after the appendectomy peritoneal troubles analogous to those which caused the disturbance called chronic appendicitis, and (3) there were psychic troubles of such a nature as to cause a return of the symptoms at first labeled appendicitis.

Consequently he holds it wrong for physicians to speak of a syndrome as attributable to chronic appendicitis which is characterized by spontaneous or provoked pain in the right iliac fossa, digestive disorders, and by changes in the patient's general health. In fact, he agrees with Brunn that the nature of appendiceal lesions is such that they cannot correctly be characterized clinically as chronic appendicitis.

KELLOGG SPEED.

DELIBERATELY to cast aside historical development, discussion of old theories and surgical procedures long since abandoned, together with obsolete bibliographic references as excess baggage, requires courage in the exposition of any surgical subject. Potel's treatise on orthopedics[4] has set out so to do. He admits that instead of offering the practitioners 50 different methods of caring for an orthopedic condition he presents only one which he considers suitable.

The long held idea that amniotic bands and adhesions were the cause of most congenital deformities is held up to ridicule, and a pathological classification of human malformations is offered. Hereditary influence of congenital malformations is strongly fought for and these deformities are divided into those of osteogenesis, joint, muscle, cellular tissue, and blood vessel malformations. The acquired malformations are interpreted to cover everything from ununited fracture of the neck of the femur through stiff joints to hallux valgus. Treatment of all types is given.

The illustrations of congenital deformities, numbering 400, are very good. But the value to the practitioner of some of these given in the discussion of treatment of acquired deformities is doubtful, for example the Murphy method of arthroplasty.

The worth of this monograph lies chiefly in the classification and illustration of congenital deform-

[1] GRAY'S ANATOMY. Edited by Warren H. Lewis, B.S., M.D. 22nd ed. Philadelphia and New York: Lea & Febiger, 1924.

[2] LE PANCREATITI. By Dott. Domenico Calzavara. Bologna: Poligrafici Riuniti, 1924.

[3] LES COLOTYPHLITES ET LE SYNDROME DE LA FOSSE ILIAQUE DROIT; (Appendicites, Péricolites, Colotyphlites). By Le Docteur A. C. Guillaume. Paris: Librairie Octave Doin, 1924.

[4] TRAITÉ PRATIQUE D'ORTHOPÉDIE. By Dr. G. Potel. Paris: Octave Doin, 1924.

ities; in acquired conditions it will fall short of the ideas and scope of work undertaken by the American orthopedist. KELLOGG SPEED.

IT is to be regretted that an English translation of the work of Voelcker and Wossidlo[1] devoted entirely to the technique of urological operations, has not appeared. In the first edition the chapter on prostatic operations was contributed by the late Dr. H. Wossidlo and his place is taken by Voelcker in the present edition. Another change is due to the death of Professor Zuckerkandl. His chapter on ureter operations in this second edition is well written by two of his former assistants, Rubritius and Paschkis.

The book leaves nothing to be wished for, from the standpoint of paper, illustrations, etc. Its purpose is to give detailed description of the most common operations in urology for the benefit of the specialist, as well as to keep the general surgeon informed as to the progress in this special field. In some of the chapters, operations and methods of treatment that are only of historic value are still included, without any reference to their having been generally discarded.

Of especial value are the chapters of Kielleutner on methods of examination of the urethra; Kuemmel on kidney operations; Rubritius and Paschkis on ureteral technique; and Kneise on urological operations in the female.

[1] UROLOGISCHE OPERATIONSLEHRE. By Prof. Dr. Fritz Voelcker and Dr. Erich Wossidlo. 2d ed. Leipzig: Georg Thieme, 1924.

The recent English and American urological literature especially on diagnostic instruments and operative technique has not been consulted as freely as it might have been. In the chapter on bladder operations by Voelcker, one might expect to see reference to the use of radium in connection with the operative procedures for bladder malignancy. The description of the technique of nearly every urological operation is taken up in a more detailed manner than is possible in the average text book and is supplemented by many colored illustrations.

Altogether, the book is the best of its kind which has yet appeared, and should be in the library of every urologist. D. N. EISENDRATH.

TEN volumes for the Child Health Library[2] have recently been received. The books are written by well known authors, and the subjects are ones of much interest to mothers. The books are made up in vest pocket size, the subject matter is concise, and in all we believe the volumes are well worth while. A. B. K.

[2] CHILD HEALTH LIBRARY: vol. i—Prenatal Care and the Baby's Birth, by Harbeck Halsted, M.D.; vol. ii—Babies—Their Feeding and Care, by Louis G. Schroeder, M.D.; vol. iii—The Neglected Age, the Child from Two to Six, by Bernard S. Denzer, M.D.; vol. iv—Dangers of the School Age, by M. Alice Asserson, M.D.; vol. v—Diseases of Childhood, by Stafford McLean, M.D.; vol. vi—Hygiene of the Mouth and Teeth, by Thaddeus P. Hyatt, D.D.S.; vol. vii—What Children of Various Ages Should Eat, by Lucy H. Gillett, M.A.; vol. viii—How Children Ought to Grow, by John C. Gebhart; vol. ix—Psychology of the Child, by David Mitchell, Ph.D.; vol. x—Educational Problems, by David Mitchell, Ph.D. New York: Robert K. Haas, Inc., 1924.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

INTERNATIONAL CLINICS; a Quarterly of Illustrated Clinical Lectures and Especially Prepared Original Articles. Edited by Henry W. Cattell, M.D. Philadelphia: J. B. Lippincott Company, 1924.

THE OPHTHALMIC YEAR BOOK. vol. xx. Edited by Edward Jackson and William H. Crisp. Chicago: Cphthalmic Publishing Company, 1924.

ANATOMIA TOPOGRAFICA; Programa explicativo, con un Complemento referente a las ideas anatómicas modernas. By Dr. Elpidio Stincer. Havana, Cuba: Compania Impresora Industrail, S. A., 1924.

TRAITÉ PRATIQUE D'ORTHOFÉDIE. By Dr. G. Potel. Paris: Librairie Cctave Doin, 1924.

ANNUAL REPORT OF THE SURGEON GENERAL OF THE PUBLIC HEALTH SERVICE OF THE UNITED STATES. Washington: Government Printing Office, 1924.

WERDEN UND WIRKEN EINES DEUTSCHEN FRAUENARZTES. By A. Martin. Berlin: S. Karger, 1924.

GUY PATIN AND THE MEDICAL PROFESSION IN PARIS IN THE XVIITH CENTURY. By Francis R. Packard, M.D. New York: Paul B. Hoeber, Inc., 1925.

IRRTUEMER DER ALLGEMEINEN DIAGNOSTIK UND THERAPIE SOWIE DEREN VERHUETUNG. Edited by Prof. Dr. J. Schwalbe. No. 4.—IRRTUEMER DER ROENTGENDIAGNOSITK UND STRAHLENTHERAPIE. Edited by Prof. Dr. R. Grashey. Leipzig: Georg Thieme, 1924.

OPERATIVE SURGERY. vol. vi and General Index. By Warren Stone Bickam, M.D. Philadelphia: W. B. Saunders Company, 1924.

THE ADVANCE OF ORTHOPÆDIC SURGERY. By A. H. Tubby, C.B., C.M.G., M.S. (Lond.), F.R.C.S. (Eng.), F.S.A. London: H. K. Lewis & Co., Ltd.

GYNECOLOGY; Medical and Surgical. By P. Brooke Bland, M.D. Philadelphia: F. A. Davis Company, Publishers, 1924.

PRINCIPLE OF EARLY ACTIVE MOVEMENT IN TREATING FRACTURES OF THE UPPER EXTREMITY. By J. W. Dowden. Edinburgh: Oliver & Boyd, 1924.

PRACTICAL LECTURES. Delivered under the Auspices of The Medical Society of the County of Kings, Brooklyn. New York: Paul B. Hoeber, Inc., 1924.

LES HÉPATITES DYSENTÉRIQUES ET LEUR TRAITEMENT. By A. Valassopoulo and Pavlos Pétridis. Paris: Masson and Company, 1924.

BIOLOGIE UND PATHOLOGIE DES WEIBES; Ein Handbuch der Frauenheilkunde und Geburtshilfe. No. 12. By Josef Halban and Ludwig Seitz. Berlin: Urban & Schwarzenberg, 1924.

THE PNEUMOCOCCUS AND PNEUMOCOCCAL AFFECTIONS. By L. Cotoni, C. Truche and Mille A. Raphael. English ed. by D. S. Page, M.A., M.B. (Contab.) D.P.H., and Eva Morton, M.R.C.S. (Eng.), L.R.C.P. (Lond.). London: John Bale Sons & Danielsson, Ltd., 1924.

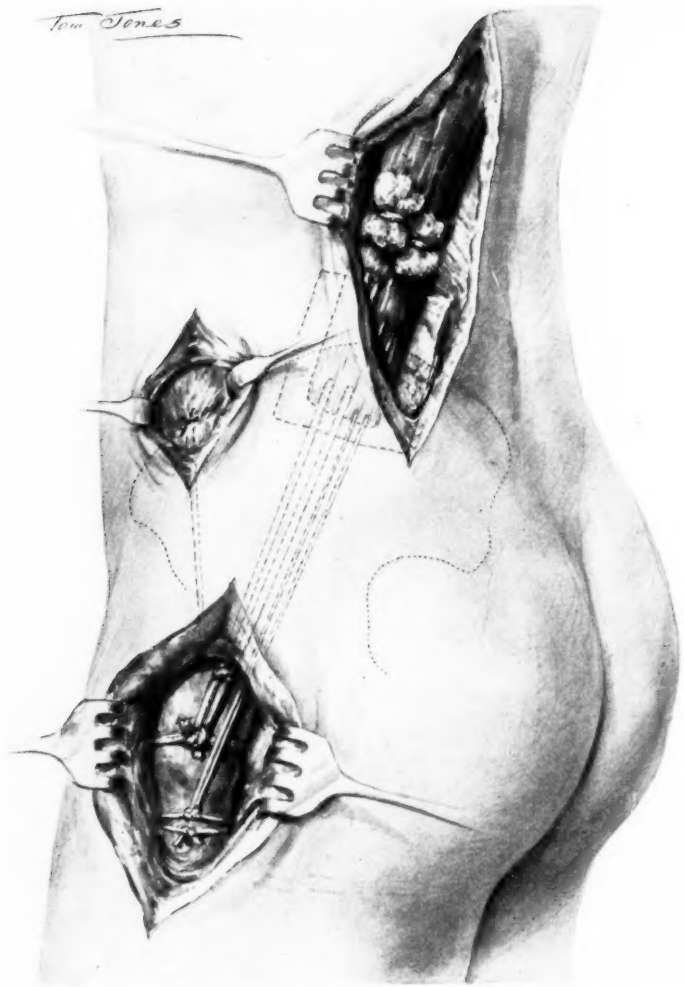


Fig. 5. The silk cords have all been securely tied with moderate tension on the erector spinæ muscle. A rectangular piece of fascia, shown by dotted lines, has been sutured over the crest of the ilium and affords a smooth sliding surface. The short incision exposes the anterior portion of the crest of the ilium and the dotted line indicates an additional cord of silk which is attached to the periosteum of the iliac crest above and the tip of the greater trochanter below. All incisions are closed without drainage.

The Substitution of the Erector Spinæ for Paralyzed Gluteal Muscles.
—Philip H. Kreuscher.